THE
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"ELECTRICAL REVIEW."

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COLLIERY MANAGERS AND ELECTRICITY.

THE *Colliery Manager* deplores the attitude of mining engineers towards the use of electricity in mines, as exhibited in the discussions on electrical matters at the recent meeting of the Institution of Mining Engineers, and regrets the conservatism of the colliery manager in general. But is the colliery manager wholly to blame? Is it not rather the fault of his position and training? It must be remembered that a mining engineer's knowledge of mechanical and electrical engineering is limited to its application to mining operations, and to the requirements of the Coal Mines Regulation Act, which makes the colliery manager responsible for all the machinery. In a large modern colliery, mechanical and electrical engineering enters appreciably into the successful development of the property, and the large amount of capital invested in the plant, and its efficient superintendence is sufficient to occupy a trained engineer. The law, however, whilst insisting upon a service or apprenticeship of five years *underground* before a candidate is allowed to sit for a certificate of competency, demands no other knowledge or experience of mechanical or electrical engineering beyond that necessary to answer a few elementary questions. His experience in this respect is usually limited to existing plants at collieries with which he may be acquainted; as he does not go into the workshops and take part in the design or construction of machinery, he naturally grows up with somewhat narrow views, and tenaciously holds to the appliances and principles of his early days. It has been asserted that, although colliery managers in Germany are more highly scientifically trained than in this country, they are not such good "pitmen." To be a good "pitman" is the first essential in working and winning large areas of coal. Electricity is of comparatively recent introduction, and many colliery managers having had no opportunity of gaining electrical experience, are dependent upon the professional opinions of qualified engineers. But when one engineer states that only high-pressure three-phase plants should be adopted as —colliery managers are carefully informed—is done in Germany, and that all the machinery should be of German manufacture, while another asserts that low-pressure continuous current plants only should be installed, their hesitancy is more or less justifiable. The tendency of the times is towards specialisation, and if the responsibility could be transferred to properly trained mechanical engineers, there would not in all probability be that tardiness or fear in adopting any new mechanical or electrical appliance which is at present shown, and would do much to clear away what are at present seeming difficulties. A step in the right direction has been taken by the North of England Institute of Mining and Mechanical Engineers,

who, in conjunction with the Durham College of Science, have started classes for the training of colliery engineers.

We have no wish or desire, in any way to depreciate the abilities of colliery managers, who's capability will be evident to anyone who realises the magnitude of their duties; but is not too much expected of them? No railway company, for instance, expects its general manager to be an expert in all departments of railway engineering and management; the captain of a ship is not expected to be an expert in marine engineering. Why, then, should a colliery manager be expected to be an expert "pitman," and, at the same time, an expert mechanical and electrical engineer? Why not make the mechanical engineer jointly responsible with the mining engineer. We commend these observations to all interested in the efficient working of collieries.

Speed and Public Safety.

In this issue of the ELECTRICAL REVIEW we publish a letter from the Secretary of the Society of Motor Manufacturers and Traders, to the Public Control Committee of the London County Council. We also reproduce a remarkable contribution to the literature of the motor-car industry, from the pen of Dr. Louis Bell, entitled "Speed and Public Safety."

The vested interests of the one, and the common sense in the public interest of the other, are as unlike as the proverbial chalk and cheese, and if Mr. Woodfine cannot bring more weighty arguments before the London County Council, his case is indeed a hopeless one.

His platitudes as to the rate of speed attained by horse-drawn vehicles and electric trams, are as weak as they are pointless; the fast automobile, as Dr. Bell urges, is not a common carrier nor a public convenience.

To cite the Prime Minister's opinion that motor-cars are more under control, and less dangerous, than trams running on fixed rails, because the latter cannot change their course for other traffic, is too absurd to be taken seriously. The very safety of pedestrians and the drivers of other vehicles, depends upon their knowledge that the trams cannot deviate from their path, and if Mr. Balfour possessed only a modicum of the engineering skill of the great statesman who has just passed away and left the world all the poorer, he would never have given utterance to such a transparent fallacy.

Again, how does the worthy Secretary make out that the speed of 10 miles an hour for motor vehicles now being placed on the streets of London, will considerably diminish their usefulness? Only in June last Lieut.-Col. Crompton stated at the Engineering Conference, that a few years hence the speed of traffic in the streets of the Metropolis would be increased by the use of motor vehicles, from its *present average of 5 miles* to 10 miles per hour! Surely Mr. Woodfine has put the cart before the horse.

The observations made in Victoria Street, by A.A.C.S., if we mistake not, may carry great weight with the Society of Motor Manufacturers, but certainly not with Sir Albert Muntz, who has recently administered several well deserved and severe rebukes to the well-known gentleman, who under those initials may be identified as one not wholly disinterested in matters pertaining to the motor-car.

To Mr. Woodfine, A.A.C.S., the Public Control Committee of the London County Council, and to the Prime Minister himself, we commend the careful perusal of Dr. Bell's paper, in the belief that if the suggestions therein set forth are carefully observed in this country, we may possibly reduce the number of accidents which have hitherto been of almost daily occurrence, to a minimum.

One point we think has never been brought prominently home to the motorist or to the man in danger of being run down. The ordinary pedestrian—we will take him in the country where motor scorching is most rampant—saunters along at a speed not exceeding, say, 2½ miles an hour. Suppose the motor fiend is driving at 50, as he often does! While the man, woman or child on foot moves one yard, the car travels no less than 20! Meeting a car travelling at this speed at a cross road, or going round a bend within 20 yards of one, would necessitate more than ordinary agility on the part of the pedestrian to steer clear of an accident.

The judging of a safe or danger distance has not yet formed part of the motorist's education; it is for him to avoid the man in the street, who has the first right to the road. With everything that Dr. Bell urges so clearly and unmistakably we are in cordial agreement.

The Second Mosely Commission.

MR. ALFRED MOSELY, C.M.G., of Bristol, bids fair to become a benefactor of no mean order to the nation to which he belongs. Not content with having borne the heavy charges and directed the energies of his recent commission of trades union delegates, who were thus given an opportunity of investigating on the spot, the character and habits of the American workmen, as well as the relationship existing between him and his employer, Mr. Mosely now intends to conduct to the United States a body of professional teachers, of experts in education, and of directors thereof, of men of commerce and high intellect, who shall study, jointly and severally, the methods adopted, and the results achieved by those representative educational establishments in the States of which Americans are justly proud. The names of the Commissioners selected have been published by the daily press. We find among them elementary and advanced teachers, teachers of specialised subjects, members of Parliament, members of Chambers of Commerce, members of borough and county education committees, general and "scientific" University professors, clergymen of the Church of England, and at least one member of the Society of Jesus. We, naturally, are most interested in seeing the names of Prof. Ayrton, Dr. Maclean of Glasgow, and Prof. Ripper of Sheffield, among the number, and we hope shortly to find that of a worthy substitute in chemistry for Sir William Ramsay, who has been compelled to resign. The Commission was to have started last year, but had to be postponed. It will apparently be conducted on lines parallel to those of the former one; *i.e.*, for part of the time the members will keep together, and investigate jointly; afterwards they will separate into units or small committees. Eventually, we gather, the Commissioners will report as their predecessors did; that is, we shall not be given a boiled-down summary of the general results, but a vastly more valuable collection of reports drawn up either by individuals or by each section of the Commission, which has investigated one particular branch of the inquiry. Nevertheless, we shall look to Mr. Mosely himself to write us a preface, or to give us his own impressions as a man of affairs; for his remarks, with their obvious common-sense and impartiality, formed not the least useful feature of the former report. The itinerary of the Commission has been drawn up with the assistance of President Butler, of Columbia, and includes that university, Yale, Harvard, Cornell, the Massachusetts Institute of Technology, the Pennsylvania and the John Hopkins Universities, the Drexel Institute; and numerous elementary, higher, commercial and technical schools, for girls as well as boys in New York, Baltimore, Washington, Pittsburg, Chicago, Detroit, Niagara Falls, Schenectady, Albany, and possibly

California. The information collected will undoubtedly be of the utmost importance. That gained by the trades unionists was sufficiently valuable, but it was calculated to benefit primarily those trades unions and those working men of this country who were not too proud and conceited to take advantage of it. This Commission will touch a higher class of society: the legislative and executive members of our educational authorities; and, appealing to more highly cultured men, its lessons will be the more readily and the more permanently taken to heart.

It must not be assumed that our average educational establishment is as bad as the average British journalist delights in proclaiming it, nor the American institution so perfect as he and the American journalist unite in representing it. It is apparently as "poor copy" for the Briton to praise anything British, as for the American to decry anything trans-Atlantic. Still, we have certainly much to learn and copy, and possibly something to avoid. There are three questions which cannot be conclusively answered without more or less bias, questions which Mr. Mosely's commission will answer or give us the material for answering. We do not know whether, or to what extent and why, the average British boy leaving either a public or a private school, is less fitted than a foreign boy at once to take full advantage of the training given at a pure or applied university. We do not altogether know whether, or to what extent and why, the average British youth leaving either a good college, a pure or an applied university, is less fitted than a foreign boy at once to be useful in commerce or in technical industry (as the case may be). We want to know authoritatively whether the foreign manufacturer or commercialist is not much more willing than his British rival to take a youth from college or university knowing him not to be of much immediate use, but knowing, also, that only in the laboratory or office of a works where competitive business is carried out can real technical or commercial ability be acquired; and whether the foreign manufacturer is not more liberal in his ideas of salary and laboratory equipment than is the average Englishman. In a word, granting that technical and scientific ability is less utilised in British factories than abroad, we want authoritative opinions or responsible data for judging on whom the blame must rest—the English youth, his elementary schoolmaster, his college professor, or the capitalist. If, as seems reasonable to expect, the blame must be distributed, we want means of assessing it fairly. And this is the kind of information we look to receive from Mr. Mosely's educational commission, finding it either recorded explicitly, or hidden between the lines of the reports which are eventually to be published.

Standardisation of Rail Sections.

THE first fruits of the labours of the Engineering Standards Committtee are to hand in the form of standard sections and specifications of tramway rails and fish-plates. Taken as a whole, the specification represents reliable practice, which, if it does not coincide exactly with the varied opinions of consultants and manufacturers, will at least form a valuable guide to those engineers who are unhampered by traditional practice. The specification covers all the usual points, including chemical composition and analysis, section, weight, and general dimensions.

The permissible variations from template are somewhat fine, being $\frac{1}{32}$ in. in total height, under or over, but in the distance between the fishing angles the variation must not exceed $\frac{1}{64}$ in. above or below standard dimensions. Surely this is expecting too much from the British workman; from experience we would suggest its impossibility in the case of foreign rails.

Among other clauses are those dealing with branding, which will render both rails and fish-plates clearly distinguishable; for testing, an ultimate tensile strength of 40 tons per sq. in. with an elongation of not less than 12 per cent. in 2 in., being called for; bending sideways, to a curve of 30 ft. radius, and an impact test, in which a weight of not less than a ton must fall through 15 ft. or more, according to weight of rail, on to a selected length of rail, supported on bearings 3 ft. 6 in. apart. This latter test appears to have been copied from standard railway practice, notwithstanding that the conditions of life there are very different, and we should have thought that a more suitable test could have been substituted. Certain holes are specified to be made in each rail, if required by the engineer and purchaser, and among them we note those required for electric bonding. A specification of fish-plates follows, and 10 sheets of standard rail and fish-plate sections varying from 90 lbs. to 116 lbs. per yard, the alternate sections being for use on curves. A further standard tire profile for arc wheels is added on sheet No. 11.

We have nothing but good wishes for the labours of this Committee, notwithstanding that the ultimate value of standardising tramway rails is, to say the least, questionable.

Old-established consulting engineers will probably cling to their past practice, and it would also be contrary to the past practices of municipal authorities to pass over an alternative foreign tender for rails of inferior design and workmanship if the price or conditions of payment offered inducements in that direction. It will generally be conceded that English tramway rails are at the present time the best obtainable, and if the demand for the standard sections became anything like general, it is possible that cheaper production, and the possibility of carrying stocks, may lead to decreased prices and great improvement in deliveries.

The Relationship of Science to Industry.

AN extremely able address upon this subject was delivered by Sir Philip Magnus before a conference held at Oxford on August 20th. After quoting the statistics relating to scientific education in Germany, which have been published lately, Sir Philip remarked that whilst the absolute number of students in German universities, technical, and other high schools is nearly three times what it was 30 years ago, the proportion of such students to the total male population has doubled, and now stands at 16·78 per 10,000. As these students cost the Government about £12 per annum each net, it follows that the Government is contributing at least £500,000 a year towards the expenses of higher education. This includes the maintenance of the universities; "but it should always be remembered that most of the discoveries made in Germany which have proved of permanent value to German trade have been made in the laboratories of university professors." Passing to our own needs, Sir Philip mentioned the £20,000 a year which the L.C.C. may perhaps agree to contribute to the proposed technical university for London, stating that it would not be sufficient for the purpose in view and ought to be supplemented by a State grant. Nevertheless, much better results might be obtained from the money already available, if the existing educational establishments (of the metropolis principally) were better co-ordinated and more economically controlled. The professors, too, must be given sufficient leisure to pursue their own independent inquiries while assisting the senior students in research. The country must possess an army of highly-trained and intelligent scientific experts to act as the "intelligence department" of all factories; but such an army will avail little unless manufacturers, managers, and employers of labour are "so trained as to be capable of recognising and appreciating at its real value the help which science might render to industry." Markets, moreover, do not grow spontaneously, but have to be made; and there is a law of inertia in commerce as in physics which helps those who first create a market to keep it. Finally, it is to be remembered that when we reproach the Government with its parsimony and reluctance to spend on higher education the money that is needed to give us equal advantages in the keen international competition for trade; and when we appeal to millionaires to endow universities and schools for higher scientific study, we want to see our country produce not only what is cheapest but what is best.

D

THE GAS ENGINE AND ITS FUTURE.

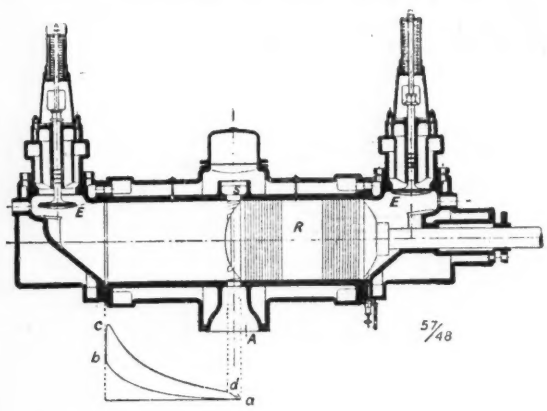
(*Continued from page* 249.)

The Körting Type (*continued*).

It will be obvious that for this type of engine the gas having to pass through the pumps must be so free from tar and dust as not to necessitate the frequent pulling to pieces and cleaning of these portions of the engine. The air and gas pumps necessitate an expenditure of power, but this is counter-balanced by the improved cyclic regularity resulting from the more frequent impulses.

The external crosshead, necessitated by the closing of the front end of the cylinder to obtain the double action, is regarded by many engineers as an important advantage, the gudgeon pin being more readily accessible than when surrounded by the trunk piston common in the four-cycle engines.

The illustration herewith shows that when the piston, R, is on the forward dead centre, the exhaust ports, S, round the centre of the working cylinder are uncovered, their opening having commenced when the face of the piston was in the position represented by *d* on the indicator diagram. At that moment the cylinder pressure, still apparent from the expansion curve, falls to atmosphere; at the same time the admission valve, E, is opened by its cam, and a scavenging



Longitudinal Section through Cylinder, Körting Gas Engine.

charge of pure air, at a pressure of 5 or 6 lbs. above the atmosphere, is sent into the cylinder by the air pump, effectually clearing out the products of combustion. The gas pump, whose discharge has been delayed by suitable means, now sends a supply of gas into the cylinder, which discharge, mingling with that of the air pump, forms the combustible mixture necessary for the power stroke. The exhaust ports, S, are then closed by the return stroke of the power piston, P; the mixture is compressed in the ordinary way, ignited electrically at two distinct points to ensure complete firing, and the impulse is transmitted to the piston. The same cycle is repeated at each end of the cylinder alternately, the air pump thoroughly sweeping all burnt products through the exhaust ports, S, and thus entirely preventing the ignition of the incoming charge by contact with the hot gases remaining in the cylinder.

Examination of the cylinder after months of steady running has proved that the ports were absolutely clean and the bars not unduly worn.

A special advantage of the independent pump is that the air and gas are kept entirely separate till they reach the admission valve, so that there is no accumulation of explosive mixture outside the working cylinder itself, and therefore no back-firing can occur.

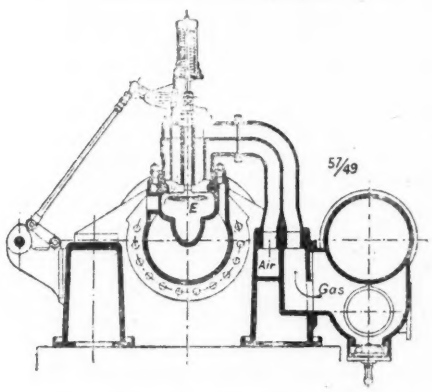
Regulation is not effected on the "hit-or-miss" principle, but by altering the quantity of the mixture admitted to the cylinder. During periods of light load, the valve admitting gas to the cylinder is kept closed for a longer period than during heavy loads, and *vice versâ*; so that the charge is proportioned to the work done, though the quality of the mixture at the points of ignition is maintained practically constant, thus ensuring full ignition.

This system of governing, though perhaps not quite so economical as the "hit-or-miss," is more advantageous for maintaining the steady running of the engine for electrical purposes. The makers maintain that they can obtain as high a degree of cyclic regularity, without the aid of excessively heavy fly-wheels, as can be got with the best design of steam engine.

The gaseous mixture is fired, as already stated, at two independent points at each end of the cylinder, and a neat arrangement is provided whereby the period of ignition can be made earlier or later by hand while the engine is running, thus ensuring the correct point of ignition for the quality of gas employed; blast furnace gas requires to be ignited earlier in the stroke than producer gas, and the latter, in like manner, earlier than town's gas.

The starting of this engine is effected by compressed air, at a pressure of about 110 lbs. per sq. in., a small compressor with a reservoir for the air being usually included with the engine. The rapidity with which large gas engines can be started, when compared with the warming up of cylinders, opening and shutting of drain cocks, and the other movements incidental to the two or even three hours' preparation required for starting a steam engine, must commend itself to electric power and lighting station engineers, the operation of starting gas engines of large units only occupying as many minutes as similar-sized steam engines require hours.

The Körting type of engine is efficiently water cooled at all parts subject to high temperatures, including the cylinder



Cross-Section through Cylinder and Pumps, Körting Gas Engine.

heads and pistons, while lubrication is forced and practically automatic throughout.

The following particulars of the working results obtained with a 500-H.P. blowing engine of this type will be of interest:—

The engine worked for six months, sometimes for three or four weeks without a single stop. The oil consumption for the whole engine per 24 hours was just under 2 gallons in the cylinder and $1\frac{2}{3}$ gallons for the other parts, of which $\frac{3}{4}$ gallon was for the blowing cylinder.

When the valve box at the back was unscrewed, and the main piston removed, the inside of the cylinder walls was in perfect condition. The bridges between the exhaust slots were perfectly smooth and even, and there were only thin flaky crusts in a very few places on the edges of the slots themselves; the piston was also in perfect condition, the rings had borne well on their whole surface, and could be easily moved. The glands were in good order, and were replaced without renewal or repair.

The seats of the inlet valves were perfectly clean and smooth, although there was a small ring of crust on the circumference. The slide valves of the gas-pump and air-pump were perfectly bright, and showed no sign of any incrustation.

The igniters were in good condition; it seems advisable to change these every four or five weeks. For this purpose the engine has to be stopped for not longer than 10 minutes.

(*To be continued.*)

THE CALCULATOR BOARD AND GRAPHIC METHODS.*

A convenient device named—in brief—a "Calculator board" has been brought out by Mr. E. Raymond-Barker. It is an apparatus which has for object the facilitating of graphic methods of calculation, especially as applied to the electrical localisation of faults in submarine cables.

Although the calculator board has been brought out in this connection, it is adaptable for use in many and varied branches of quantitative research, whether electrical or mechanical, statistical or financial.

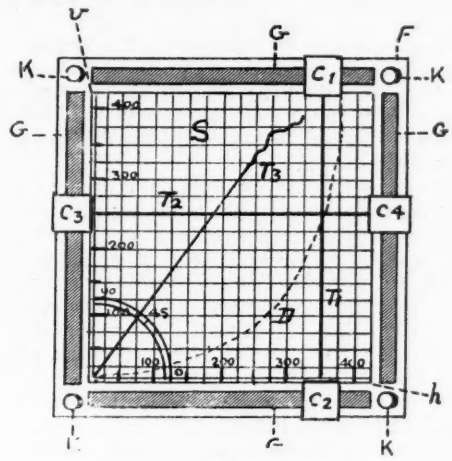


Fig. 1.—Front View.

As prepared for use in general electrical and fault-localisation methods, the calculator board may broadly be considered under two principal aspects.

Firstly:—(*a*) The calculator board comprises a permanent record of a great many useful curves from which, by means of two intersecting sets of cursors acting at right angles to each other, calculations based on corresponding formulæ may be at once solved.

This arrangement covers a variety of ground whether in regard to localisation formulæ, temperature coefficients, or volts necessary to drive certain required current powers,

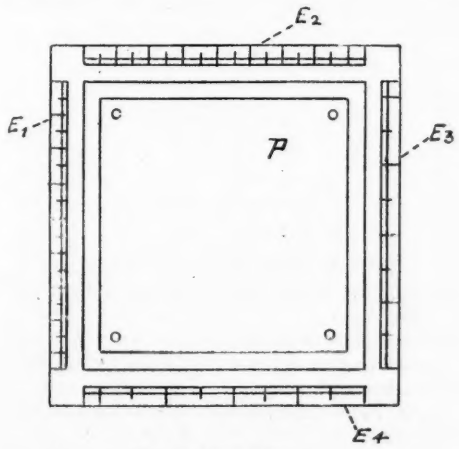


Fig. 2.—Back View.

through different resistances, to cable breaks—as well as other cognate matters.

Secondly:—(*b*) The calculator board affords great facilities for graphic methods of calculation, and for the plotting of curves.

Owing to the working surface of the board being a somewhat roughened, though transparent, sheet of celluloid, horn, or glass, all pencil lines, whether plotted curves or geometrical figures, remain visible thereon as long as they may be required.

Tracings may then be made from the said pencil diagrams or plotted curves, after which the celluloid working surface may be cleaned in readiness for fresh pencil work.

Over and above these two main purposes, the calculator board may be used as an ordinary drawing board, with extra facilities for perfect alignment and for drawings to scale.

Regarding details and operation comprised under foregoing heading *a*:—

Figs. 1, 2 and 3 show the general principles of the calculator board, which in practice may be of any convenient

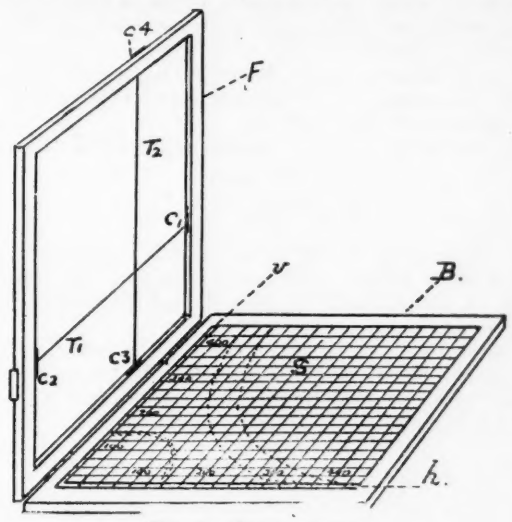


Fig. 3.—General View.

size, say 18 in. square, not inclusive of the space necessary for the two sets of graduated scales and the surrounding wooden framework.

Fig. 1 represents front view, fig. 2 back view, and fig. 3 general front view with hinged frame shown open.

In course of manufacture this arrangement has been modified, and it has been found more convenient for the top frame, instead of being hinged, to be attached to the main board by thumb screws.

B is a rectangular board, say 21 in. square over all.

On the front of this board is laid a sheet of sectional paper S, on which may be permanently plotted useful linear curves symbolised by curve D, shown in fig. 1.

Sheet S is provided with vertical and horizontal scales *v*, and *h* for the convenient evaluation of the curves permanently plotted on the sheet.

In practice, S is a sun-print copy of a sheet of useful curves, any number of multiple copies of which can be had from a standard curve sheet 18 in. × 18 in., arranged by the inventor expressly for the calculator board.

Fig. 4, shows the calculator board curve-sheet, as used in practice, photographically reduced to about ⅛th actual size.

This sheet comprises several curves here mentioned, the first three of which were originally calculated by Mr. Schaefer, and published by Mr. J. Elton Young, in his useful book: "Electrical Testing for Telegraph Engineers." For the calculator board these three curves have been recalculated to a larger scale than as hitherto published. All the other curves on the board are given for the first time.

List of Curves Permanently Plotted on Calculator Board.

Curve $\dfrac{\sqrt[1\cdot3]{n}}{\sqrt[1\cdot3]{n}-1}$

Curve $\sqrt[1\cdot3]{n}$

Curve $(n)^{4\cdot3}$

} For Schaefer methods, where n = ratio of any two current powers.

Curve $\dfrac{\sqrt{n}}{\sqrt{n}-1}$:—Useful for Kennelly test.

* An improved drawing board and apparatus for facilitating graphic methods of calculation, and the like. (Provisionally protected.)

Three curves, severally for expressions :—

$$\sqrt{\text{M.A.}}, \quad \frac{1}{\sqrt{\text{M.A.}}}, \quad \frac{1}{\text{M.A.}},$$

where M.A. = milliamperes passing to cable. These are useful for Jona's graphic methods for computing true resistance to cable rupture.

Two curves useful in the Rymer-Jones (modification of Cann's) test on broken cables.

Curve for reducing any reasonable difference between two temperatures expressed in degrees F. to equivalent difference expressed in degrees C.

Curve for obtaining Clark, Forde, Taylor temperature coefficient for copper for any difference between two temperatures up to a difference of 46° F.

Three curves for correcting resistance coils wound with—

1. German silver,
2. Platinum silver,
3. Platinoid,

for any difference under 46° F. between two temperatures.

Four curves indicating voltage and cells necessary to pass 5, 10, 20, 25 milliamperes direct through resistance 0 to 4,600 ohms.

Four curves indicating voltage and cells necessary to pass 5, 10, 20, 25 milliamperes through Wheatstone bridge system with ratio 1,000 : 1,000 and cable resistance of 0 to 4,600 ohms.

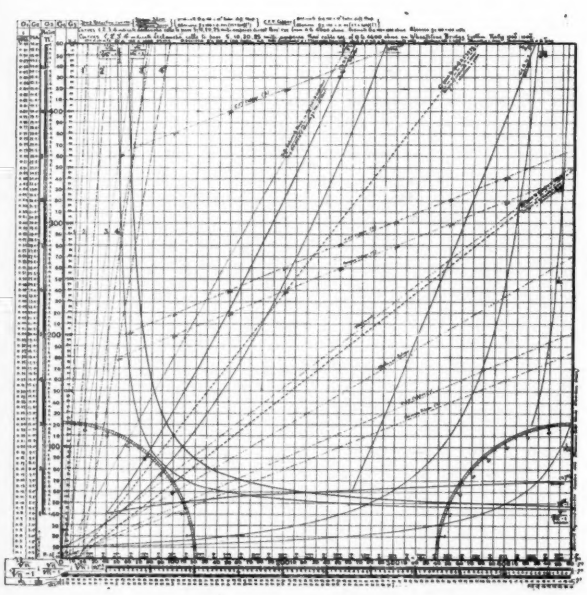


Fig. 4.

These last-mentioned eight curves are easily extended if required for any resistance higher than 4,600 ohms.

The curve sheet shown reduced in fig. 4 bears clear directions as to use and value of the graduated scales.

The rectangular board B, on which is laid the curve sheet S, is contained in a rectangular frame, F, of seasoned wood.

Two pairs of cursors, $C_1 \ldots C_2$ and $C_3 \ldots C_4$ are fitted to the frame F, along the sides of which they may be moved, $C_1 \ldots C_2$ working at right angles to $C_3 \ldots C_4$.

The two cursors of each pair are adjustable respectively on opposite and parallel sides of the frame F.

Each pair of cursors are respectively inter-connected by threads T_1 and T_2, or by strips of some convenient material such as celluloid, and the two strips T_1 and T_2 intersect each other at right angles.

By the placing of the intersecting strips T_1 and T_2, so that the point of their intersection coincides with a given point on any of the under-lying linear curves—say, D in fig. 1—the abscissæ and ordinates may be read off from the graduated scales h and v to which extent respectively T_1 and T_2. For the present one practical example will suffice.

Required solution of the Schaefer expression

$$\frac{\sqrt[1\cdot3]{n}}{\sqrt[1\cdot3]{n-1}} \quad \text{where } n = 2\cdot16.$$

Bring T_1 to 2·16 on scale for n. Bring T_2 to intersect T_1 at point where T_1 intersects curve

$$\frac{\sqrt[1\cdot3]{n}}{\sqrt[1\cdot3]{n-1}}.$$

Read answer 2·23 on scale at extremity of T_2.

Millimetre scales on all four sides of the curve-sheet facilitate exact adjustment of $C_1 \ldots C_2$ and $C_3 \ldots C_4$, thereby ensuring rectangular intersection of T_1 and T_2.

Two quadrants are inscribed on the lower and opposite corners of the curve sheet (fig. 4.) By means of an extra thread or strip T_3 (fig. 1.) any angle with the horizontal may at once be obtained, and the radial line extended within the limits of the sheet S.

For the rapid evaluation of the various classes of formulæ corresponding to the curves permanently recorded on S, the curve sheet is provided with five different graduated scales—ordinates G_1, G_2, G_3, G_4, G_5; abscissæ, g_1, g_2, g_3, g_4, g_5.

G_4 and G_3 are "*omnibus*" scales suitable for general purposes, each extending to 460 millimetres. The superficial area of the curve sheet is graduated in sq. centimetres.

Blank sheets of sectional paper can be provided with the calculator board, on which the engineer, the physicist, or the statistician may each plot out curves to suit the requirements of his own special line of work.

To give some idea of the saving of labour accompanying the use of the calculator board, and of the encouragement which its well-nigh automatic solution of monotonous formulæ holds out to useful and interesting research, the following facts are quoted :—

A long voyage in a cable ship afforded opportunity for experimental verification of various fault localising methods as applied to cable-core-copper exposures in sea water under different conditions as to currents applied and duration of immersion. During these researches the following expressions, amongst others, were, by means of the permanent curves registered on S, each straightway solved by two movements—viz., of T_1 and T_2.

Expression $\dfrac{\sqrt[1\cdot3]{n}}{\sqrt[1\cdot3]{n-1}}$ 90 times,

" $\dfrac{\sqrt{n}}{\sqrt{n-1}}$ 90 times,

" $\dfrac{1}{\sqrt{\text{M.A.}}}$ 160 times,

for as many different values severally for n and m.a.

Regarding, now, arrangement and operation under foregoing heading *b* :—

Between the plane of action of cursor strips T_1, T_2, and the underlying curve sheet S lies a sheet of colourless celluloid—transparent, but with a matt or slightly roughened surface. This material is, of course, lighter than and not so breakable as ground glass.

The sheet celluloid is sufficiently transparent to permit of all curves, figures and graduated scales on the underlying sheet S being perfectly legible, while the matt surface of the overlying celluloid can be used as a working board for all kinds of pencil work, which, when done with, can easily be erased with a wet sponge.

By the combined use of the "*omnibus*" scales of abscissæ and ordinates bordering sheet S, and the cursor strips, T_1, T_2, a series of points may quickly be plotted out on the matt-surface transparent sheet celluloid, thus arriving at any required curve, such, *e.g.*, as that for showing sea temperatures at various depths, necessary for the correction to be applied to various sections of a laid submarine cable.

Once the required curve has been obtained on the basis of a sufficient number of temperature soundings, temperatures

being ordinates, and depths abscissæ, a *fac-simile* taken on tracing paper from the curve pencilled on the matt celluloid can be kept for use. A few passes with a wet sponge render the sheet celluloid ready for other work.

A good example of graphic data obtained from the calculator board is given in fig. 5, which shows, reduced to

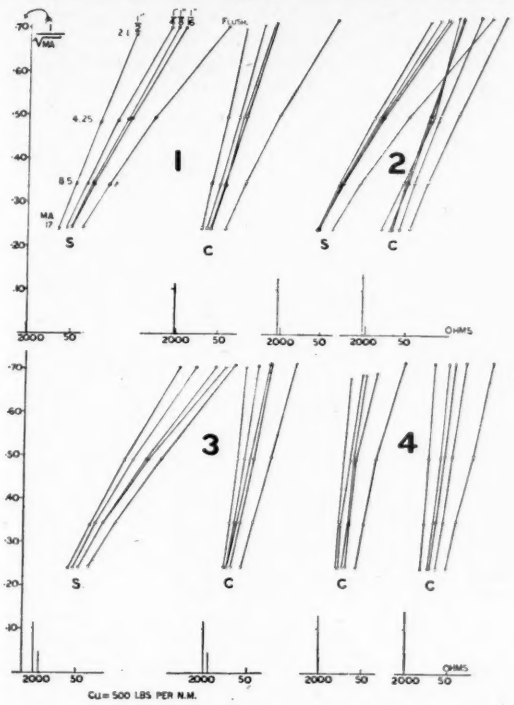


FIG. 5.

$\frac{1}{7}$ . . . . $\frac{1}{8}$ actual size, eight sets, comprising a total of 40 Jona localisation curves; "S" to scale zero, "C" to cable or false zero.

Each set of five is made up of curves from $\frac{1}{2}''$, $\frac{1}{4}''$, $\frac{1}{8}''$, $\frac{1}{16}''$, and flush-cut copper exposures in core, $\frac{500 \text{ lbs. Cu}}{315 \text{ lbs. G.P.}}$ per N.M.

The true resistance to break, which in all cases was approximately 2,000 ohms, is shown in fig. 5 by the short upright close to, or almost coinciding with, 2,000 on the horizontal line on which, also, 2,050 is given to show degree of accuracy in present case. These records were obtained on different dates during the series of experiments already alluded to.

The varied curve contours apparent in the different sets are due to changed conditions of which, here, it is not a question, although this matter may again be referred to in some future article.

The calculator board, by reason of its "*omnibus*" scales, facilitates all graphic methods such, *e.g.*, as Foster's sine or tangent galvanometer tests for internal resistance and E.M.F. of a battery; also graphic forms of the Muirhead battery test with Kelvin galvanometer; the Siemens equal potential cable fault localisation test; the Betts fault test; various fall of potential methods; and, lastly, Black's beautiful graphic method of determining "R" in the Anderson-Kennelly earth-overlap test.

The reverse side of the calculator is an improved drawing board found very useful for drawings to scale, the ruling of equidistant parallel lines on blank paper, the drawing up of electrical summary forms during cable repairs, and many other purposes.

In fig. 2, E_1 and E_2 represent hard-wood scales graduated in cm. and mm., whilst E_3, E_4, are scales in inches and 12ths of inches. The latter arrangement is very handy for scale drawings of an inch to the foot.

In fig 1, knobs K enable the board to be laid on its face without damage to cursors C_1, C_2, C_3, C_4.

The grooves, G, in the frame F (fig. 1), will be found convenient receptacles for paper strips inscribed with highly summarised data, or formulæ, a small thermometer in F°. and C.,° or any other diminutive article to the fancy of the owner of the "board."

A strong brass handle, and a water-proof cover are adjuncts of the calculator board which render it conveniently portable.

We have great pleasure in being the means of placing before our readers this most ingenious and novel device, which is the fruit of arduous labours on the part of the inventor, and will be the means of saving, to an enormous extent, the time and brains of its users.

THE ELECTROLYTIC PRODUCTION OF OXYGEN AND HYDROGEN BY THE GARUTI PROCESS.

MR. EMILE GUARINI gives a complete description, in the *Scientific American* supplement for June 27th, of the Garuti process for the electrolytic manufacture of oxygen and hydrogen from water. The author first recounts the practical difficulties in this problem, among which have been the complete separation of the gases and the excessive E.M.F. required for the decomposition. Many investigators have attempted to find a satisfactory diaphragm for this purpose, and among those things which have been tried are porcelain, pipe clay, and carbon, none of which have proved satisfactory.

In the Garuti process an iron diaphragm is used, and is so constructed that it forms a barrier between the gases above the surface of the liquid, and is perforated to allow the passage of the current below the surface of the electrolyte. It is obviously important not to allow the P.D. to exceed the decomposing value for the electrolyte on the opposite sides of this metallic diaphragm, otherwise it will act as an intermediate electrode and liberate oxygen and hydrogen, thus forming an explosive gas on both sides, but this difficulty is entirely obviated by economical considerations as, if such

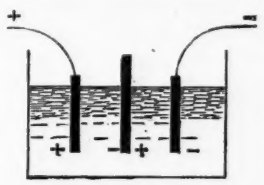


FIG. 1.

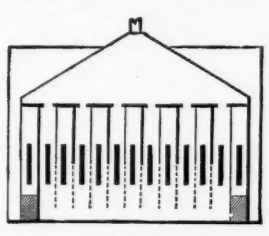


FIG. 2.

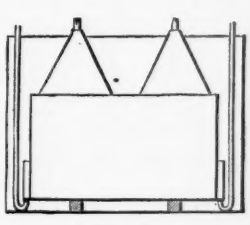


FIG. 3.

were to take place, it would be because an altogether excessive voltage was being used. The electrolyte is a 25 per cent. solution of caustic soda, and the vats and both electrodes are made of iron or steel. The electrodes are said to last several years, which fact must depend on the purity of the caustic.

The theoretical decomposition voltage would be about 1·5 volts, but in practice with a 25 per cent. solution of caustic 2·0 volts are required, or with a much weaker electrolyte 2·4 volts. The caustic, of course, remains unchanged, and only the water is decomposed.

With this latter voltage and allowing for a production of 0·4 litre of hydrogen and 0·2 litre of oxygen per ampere-hour, the production per kilowatt-hour would be 166·6 litres of hydrogen and 83·3 litres of oxygen. The production of 1 cubic metre (35 cub. ft.) of the mixed gases therefore requires four kilowatt-hours.

Fig. 1 shows diagrammatically the principle of the apparatus, the central partition just dipping below the surface of the liquid. Figs. 2 and 3 show the actual apparatus in section. There is a series of electrodes separated by metallic partitions which are perforated underneath the surface of the

electrolyte and are suspended. The hoods are so arranged that each one collects the gas from every alternate electrode, and thus one hood collects the hydrogen and the other the oxygen. This process is already being exploited in the States on a fairly large scale, and the same company is devoting a good deal of attention to the methods of utilising the gases to the best advantage in the various arts.

A CURIOUS SPECIFICATION.

THOSE representatives of electricity meter manufacturers who are not away from town on their holidays, have had during the past few days to puzzle out the meaning of one of the most curious and contradictory specifications we have recently had before us for examination. We refer to that issued on behalf of the Aston Manor Urban District Council, by Mr. R. P. Wilson, their consulting engineer.

The contract is for the supply of meters for a period of three years, though if at any time the contractor fails to deliver the full number of meters required within one week from date of order (or shall we say demand), it shall be within the power of the Council either to determine the contract or to impose a penalty of 5 per cent. of the total contract sum per week. To begin with, this loophole renders the contract practically binding only on the contractor, for the meters are of a special character.

The system of supply at Aston is three-wire direct-current 230 volts between inner and outers. The meters are to record in "watt-hours," and register direct in Board of Trade units without the employment of any constant. The sizes vary from 5 amperes to 120 amperes.

The contractors must state the no-load loss, full-load loss, and give guarantees as to the accuracy of the meters at full, one-tenth, and one-fiftieth load. This latter is surely a refinement with a five ampere meter representing, as it does, a little over one-half the current required for an ordinary 8-c.p. 230-volt lamp.

Other requirements are, noiselessness, incapacity to run on shunt-circuit only, ability to withstand for apparently an indefinite time an overload of 50 per cent., and compensation for temperature errors. These are usual, and can be met by several of the best makes now before the public.

This cannot, however, be said of the stipulation that each meter shall be provided with a resistance, or other suitable device, which, when operated by a time switch (apparently to be supplied under another contract), will cause the meter to register at exactly four times the actual rate. This is to be done without any variation in the range of accuracy, and no wonder the contractor is allowed a certain license in devising answers to the conundrum thus innocently placed before him.

Meter cases are to be returned by the Council, and the price must *not* be included in the contract, is the statement in one paragraph; the next but one states that these cases will only be returned at the request of the contractor, and then only at *his expense*.

The above are a few examples of the way in which one paragraph of the specification contradicts another, and the reference to the "time-switch" is quite insufficient to enable any tenderer without further information to prepare an offer which will at the same time be fair to the Council and to himself.

It cannot be too clearly understood that such ambiguity in drafting specifications only tends to increased prices, and it would be not only interesting but instructive to the members of the Aston Council, if, before accepting any offer which may be made to them, they made inquiries as to the sum by which the offers had been increased in order to meet the unknown risks which by the specification the tenderers are called upon to undertake.

New Switches.—In our notice of Messrs. Ward and Goldstone's switches, which appeared in our issue of August 7th, we omitted to mention that Messrs. A. W. Richards & Co., of 70 and 71, Bishopsgate Street Within, E.C., are the sole London agents, and that inquiries for these switches and British-made electrical material of any kind will be promptly attended to.

SPEED AND PUBLIC SAFETY.*

[THE PREVALENCE OF SERIOUS MISHAP—THE GREATER OPPORTUNITIES FOR ACCIDENT WITH HEAVIER AND FASTER VEHICLES—THE OPERATOR'S INTELLIGENT UNDERSTANDING OF THE DANGER SPACE AHEAD AND THE ULTIMATE POSSIBILITY OF CONTROL—THE ADDED RESPONSIBILITY OF THE PUBLIC—HIGH SPEED WITH SKILFUL HANDLING COMPARATIVELY SAFE—THE REGULATION OF RECKLESS DRIVING SHOULD NOT BE SUCH AS TO ELIMINATE ALL CONVENIENCE TO THOSE WHO OBEY THE LAW.]

BY DR. LOUIS BELL.

THE last few years have seen a very large increase in the number of fast and heavy motor-driven vehicles used in one way or another on the public roads, and the result has been so ghastly a muster-roll of accidents that public safety demands a grave consideration of the problems that have arisen. In the list of offenders must be joined in evil notoriety both recklessly driven automobiles and recklessly driven electric cars. One can hardly pick up a morning paper without finding fatalities due to both causes, and the frequency of these accidents appears to be on the increase even in proportion to the number of vehicles in service. Accidents from vehicles and from street cars have never been rare of late years, but the present epidemic of negligence demands and will receive drastic treatment if it continues much longer.

Neither the electric car nor the automobile is necessarily a menace to safety on the public street, but both may become so when carelessly managed, and in point of fact both must be so classed in numerous instances. The cause of the recent gruesome list of accidents is not to be sought in the increased speeds alone, nor in a marked increase of personal carelessness, but in the combination of high speed, involving new conditions of control, with lack of proper skill or care on the part of the operators. As has often been pointed out, the fast driving rough in a buggy has been responsible for many accidents and has often exceeded the legal rate of speed, but the same chap in a 40-mile-an-hour "Red Devil" has vastly greater opportunities in both directions, and has improved them with an assiduity worthy of a better object. Moreover, his new resource has very largely increased the proportion of killed among his victims. The electric car likewise has, in careless hands or through various chances for which the motorman may or may not be responsible, a long list of accidents to its discredit as the horse car had before it, but the ordinary tramcar is one thing and the fast inter-urban car is quite another when it comes to the question of adequate control. The result is painfully manifest in increased frequency and severity of collisions, and the present summer has started out as a record breaker in this particular.

These accidents, if accidents they can be called when reckless operation is the cause, occur in spite of undeniably better safety precautions than in the past, and an inquiry into their cause and into possible remedies is certainly pertinent.

The ostensible causes are very various, but when gone carefully over and classified, they simmer down to one exceedingly simple proposition, viz., the car was not under the control that its speed and the proximity of possible obstacles demanded. The actual cause of this lack of control may be various; in rare—very rare—instances the brakes fail though a definite fault; more commonly they fail because they have not been properly tested and inspected; the motorman may have been coasting recklessly, or may have been racing up to a blind curve in the opinion that nothing could be beyond it. In the writer's opinion, however, these collisions occur generally not through sheer carelessness in inspecting or operating the equipment, but through perhaps equally culpable ignorance as to the real meaning of proper control. Most fast interurban cars are kept in first-class operating order, supplied with good brakes, and manned by sober and intelligent crews, who would not wittingly take what they believed to be long chances.

But not one motorman in twenty fully realises the length of the dangerous space in front of his car or knows from experience what actual space is required for stopping the car at the various speeds at which he is wonted to run. Until this knowledge is generally disseminated and acted upon the present epidemic of collisions will continue. The dangerous space of a car is the distance required at any speed for stopping after the brakes are set. This distance obviously increases with the speed and weight of the car, and with any unfavourable condition of the track, and it is mainly the increased speed and weight that are responsible for the added dangers that have come with modern fast interurban cars. The actual length of the dangerous space under service conditions is so much greater than is popularly supposed that collisions can and do occur when the motormen believe themselves entirely safe. After the wreck there is a complaint that the brakes did not hold, whereas the fact is that they did hold all that could reasonably be expected, but were simply incapable of the task set before them.

In an Institute paper read last year by Mr. J. D. Keiley may be found a valuable summary of results in braking modern electric cars that ought to be read by every street railway man in the country, from the presidents down to the motormen. The experiments related to a modern car, weighing about 18 tons, and fitted successively with various brakes, the operating speeds being about 12 to 18 miles per hour. At the latter speed the space required for

* New York *Electrical Review*.

stopping varied from 101 ft. with the best attainable power brake to 205 ft. with a first-class hand brake worked for all it was worth. The track was in good condition, the brakes were in perfect order, and the stops were emergency stops, using all the pressure possible without skidding. Adding to these distances 50 per cent. to make safe allowance for unfavourable conditions of track or apparatus, and it at once becomes evident that to take an average car at this speed the dangerous space ranges from about 50 yds. to over 100 yds.; the former with power brakes, the latter with hand brakes. And it should be added that under these conditions the average power brake would show a dangerous space nearer 75 yds. than 50. These are actual experimental results not likely to be bettered appreciably. At higher speeds, which are often reached on interurban lines, the dangerous space is likely to be 100 yds. or more.

Now the application of these figures is obvious. If on an interurban line running such cars on a single track, an approaching car looms up through the fog or around a curve a couple of hundred feet ahead, a collision is practically inevitable, and unless the motormen act with great promptness and judgment it is likely to be a serious one. It is useless to charge up such an occurrence to the brakes being out of order, for they are simply incapable of doing the work set for them. The only way to safety, aside from an absolute block system, which is very hard to apply to a long interurban line, is reducing the speed at all points and times when there is not clear and visible track ahead to the extent of double the danger space. On double-track roads and as respects other vehicles the full danger space of clear track will ensure safety. Unless such an allowance of space is made the car is not under control for the purposes of public safety, and should be considered as running negligently. Once the idea of dangerous space is fully grasped, the avoidance of collisions and other accidents becomes relatively simple. No one blames a motorman who runs with due caution and keeps his car under proper control, but in order to do this he must understand what it means. On the other hand, the public is not without its increased responsibilities. It should understand that what was ample leeway in crossing a car track 10 years ago is to-day taking desperate chances, and should govern itself accordingly. A car running at even 15 miles per hour covers 22 ft. per second, and is likely to require nearly 40 yds. for a stop. Increased speed has come as the result of a general demand, and is an important factor in the comfort of urban life. The real question is the safe limit of speed when the cars share the roadway with other vehicles. Questions of right of way are comparatively simple, because the electric car is confined to a track that all may see and avoid. And as to the actual speed permissible, it is likely with present conditions that the common limit of 15 miles per hour on public roads is not far from right. That is, any considerable increase above that maximum is likely to involve considerable added danger. But whatever the nominal limit of speed the important thing is that the motorman should know his dangerous space and keep his car under control accordingly. Demands for high speed will resolve themselves into practically requiring a separate right of way, already common on fast interurban lines.

Speed questions concerning the automobile are very much more troublesome. The automobile has far less dangerous space, based on braking capacity, than the electric car, and it also can readily turn out for other vehicles. On the other hand, it has generally far greater capacity for speed and is run at higher speed in far more dangerous circumstances. The writer firmly believes that the automobile has come to stay and that it should be fairly treated and given reasonable encouragement. Nevertheless, it is only too obvious that it is often operated so recklessly that it is a grave menace to other occupants of the highways. A legal speed limit is fixed for automobiles, but everybody knows that most such vehicles are deliberately intended for far higher speeds and run above the legal limit customarily and intentionally. Furthermore, in careful hands they can do this safely and without inconvenience to anybody. A skilfully-handled machine at 20 or 25 miles an hour is far less dangerous than one in reckless hands at half such speed, but unhappily the careful handling is frequently at the lower speed and the criminal recklessness at the higher.

The whole question of safe automobile speeds resolves itself into eliminating the person who drives his auto, or causes it to be driven with impudent and brutal disregard of the rights of other travellers. The occupant of the Red Devil has just as much, and no more, privilege on the highway than Weary Raggles, plodding along toward the next township. As a class, Mr. Raggles has far more rights, for he can outvote his more speedy fellow traveller ten to one. It is altogether impudent for the latter to bluster and demand the right to butt the former into the ditch. In solemn fact, the entire contingent who owns, or habitually rides in, automobiles is, and will be for a long time to come, so minute a fraction of the population that its collective rights are utterly inconsequential in the public welfare. And of this small fraction only a small number have to be considered in relation to speed. Nine automobilists out of ten intend to be law-abiding, to pay due regard to the rights of their fellows, and to behave in all respects like decent citizens that they are. It is the tenth man who blatantly denounces all regulations as outrageous, runs at full speed through crowded streets, laughs and puts on more speed when a horse bolts, and skips the town when he runs down a pedestrian. In point of fact, he has no more "right" to career through the highways than he would have to insist on rifle shooting in the public parks.

And the task before the community is to restrain this tenth man without needlessly inconveniencing the other nine. Speed limits, as at present administered, are utterly farcical. If low enough to remove the real and serious danger it is so low as to rob the automobile of the properties that will ultimately render it most valuable. As generally constituted, the limits are so low that they are frequently passed in complete innocence, and the usual plan of police traps to catch the offenders generally gets the wrong men. No speed limit can be properly enforced as generally managed, since no man without using a stop watch can definitely state whether the speed was a quarter mile above or below the limit.

There is just one way in which a speed limit can be enforced—by absolutely forbidding the use on public highways of motor vehicles capable of operating above the limit on level ground, under penalty of permanent forfeiture of license and fine if necessary. The maximum speed of a vehicle can be tested before licensing, and re-examined if there is reason to suspect fraud. This would be drastic but effective, and it is "up to" the law-abiding majority of automobilists to see that it is made unnecessary.

It is utterly silly to prate about the spirit of the times demanding more liberal speeds, and to cite electric cars as justification. The fast automobile is not a common carrier nor a public convenience. It is and is likely to remain a private vehicle used for pleasure by a few tenths of a per cent. of the population. The automobile as a practical working vehicle for ordinary purposes will involve no serious speed questions. A speed limit of 15 miles an hour, enforced, as just noted, would probably be actually a good thing for the progress of the art, tending to the development of useful vehicles capable of running long distances under load, and eliminating most of the objectionable characters who would abandon the sport if kept to moderate speed.

From the standpoint of public safety, one of the most serious matters is the insuring of automobilists by casualty companies against damages resulting from killing or injuring their fellow travellers. If this practice continues the risks even at moderate speeds will be greatly increased. It comes as near to putting a premium on criminal carelessness as anything well can. The only proper rejoinder is to make a special criminal statute to cover injuries inflicted by vehicles of all sorts due to carelessness of the driver or his master, if a co-occupant of the vehicle. A moderate term in the penitentiary for a few offenders would settle the present difficulties more speedily than anything else, and the average jury can be trusted to convict the criminally reckless and release the innocent. Fines are worse than useless against the offenders, particularly if insured, but imprisonment would not be a nice thing to contemplate. A proper statute of this sort would render a speed limit almost needless, or at least would allow a much higher limit than at present without increasing the danger of accidents. Finally, there ought to be a statute settling a proper rule of the road for vehicles of various sorts, based on the same sort of common-sense requirements as the marine rules in universal use. Our present rules fail in not including the contingencies arising from enormous differences of speed, weight and general managing ability. The automobile is a menace to safety only when recklessly used, and regulations concerning it should be aimed at recklessness, and not made to inflict petty annoyances on the law-abiding.

THE RAMSGATE TRAMCAR ACCIDENT.—BOARD OF TRADE INQUIRY.

At the offices of the Isle of Thanet Electric Tramways Co., St. Peters, on August 19th, Colonel Von Donop, the inspector appointed by the Board of Trade, held an inquiry into the circumstances attending the tram accident which occurred in Belle Vue Road, Ramsgate, on August 12th. The authorised speed between Albion Road and Victoria Road is four miles an hour, and for the rest of the route six miles an hour. Both of the cars affected by the accident were double-decked bogie cars, and they both had hand, electric, slipper, and reversing brakes.

The driver, JOHN COLLINS, was first called. He said that he had been in the service of the company as a conductor and driver for about 18 months. At the time of the mishap all of the brakes on his car (No. 36) were in good order. He never had any difficulty in ascending or descending the steep gradients, some of which were 1 in 9. On this occasion, when about to make the descent of the hill, he gradually applied his electric brake up to the third notch, but it had no effect in checking the car. He then sanded the rails and applied the brake again up to the third notch; it acted successfully and the car slowed down to its normal speed of four miles an hour. Then, just when he was about to sound the gong to warn passengers crossing at the junction of the roads the car seemed to shoot away from him; the brake was still on at the third notch, but he could not get any sand. The handbrake was slightly applied, but not sufficiently to make the wheels skid. The electric brake was put on up to the fourth notch, and he also applied the handbrake tighter, but finding the car was still gaining speed he removed both brakes and shouted to the conductor to put on the brakes behind. He next applied his drag brake, but that had no effect at all, so he reversed his controller handle and applied the current, but without result. The collision then occurred with the up-going car, his speed being about 15 miles an hour. The rails were greasy as it had just been raining. After the accident he saw that there was still sand in the sandbox; something must have got into the sand-pipe and prevented the sand from running.

Mr. HUMPHRIES (the resident engineer and local manager) said that the instructions when the rails were greasy were for the conductor to go ahead with a sand pail which was carried on each car for such emergencies and sand the rails.

The INSPECTOR: What seems so extraordinary in your statement is all these brakes failing one after the other. I can understand an accident happening and one brake failing to act. In this case you have three brakes, the hand brake, the electric brake, and

your track brake, and you have means of reversing your current We will leave out the last one, and take the three brakes, the hand brake, the electric brake, and the track brake. You apply all these three, and one after the other they all fail. That seems an extraordinary thing?

Collins: By applying the brake and getting no sand, the wheels were locked. Other men have had cars do the same thing.

You think now the wheels were locked?—Yes, sir. When out with the car in the morning the car picked up speed with me. I applied the sand and got it under control again.

Going down that steep bit you are inclined to think you skidded the wheels with your hand brake. You know the moment the wheels skid the electric brake does not act. If you let your hand brake off, the wheels revolve and then you apply your electric brake. Don't you think it possible your hand brake skidded the wheels?—No, sir, I had not the hand brake sufficiently tight on.

If your electric brake skidded the wheels, the moment they are locked, the electric brake ceases to act and the wheels no longer skid. Therefore there is no necessity to let off the brake. Is not that so?

Mr. Humphries: Quite so. Mr. Humphries said the men were thoroughly instructed in the action of the brakes.

The Inspector: I am afraid this man has not appreciated those instructions by the way he talks about it. (To Witness): Now the track brake, what explanation can you give me of that? Did you use the track brake at all that day?—I used it going up the hill.

Did you use the track brake going down the hill?—No, sir.

Don't you use it going down some of the hills at Ramsgate?—No, sir.

Mr. Humphries: The brake is simply an emergency brake.

The Inspector: Did you use the track brake in descending hills that day?—No, sir.

Did you take any steps at all that day to see whether the track brake was in working order?—In the morning before I come out of the yard I always drop the track brake and try it.

Did you try it that morning, and did it stop your car?—Yes, sir.

Running forward?—And backward.

And it acted efficiently?—Yes.

W. A. Coppen, the conductor of the car, was next called. He had been three weeks in the service of the company. Previous to that I was being trained with another man for about a week. I have not had any training as a driver. When the driver turned round and called to him to put on the brake, he was about the centre of the car, and had to get on to the platform. He had scarcely arrived on the platform when the collision happened.

The Inspector: Then you did not put on your brakes at all?—No, sir. When I arrived at the door I saw the trolley rope twisted, indicating to me that the trolley pole had left the line.

Major Knell, who had been in the service of the company since the time the line was first opened, about two and a half years, was called. He had been driving just over a year, and was, on the afternoon of the 12th, driving car No. 30, which collided with car No. 36. He did not notice No. 36 car approaching until his car was on the interlacing line. He could see that something was wrong, and that he would not be able to pull up at his stopping place. Then concluding that there must be a collision, he shut off the current and at once reversed. The car was just beginning to move slowly back when the collision occurred. He should think car No. 36 was going at nearly 20 miles an hour at the time of the collision. It was drizzling at the time, and the rails were in a greasy condition. He had had a lot of experience with bogie cars, and had had no trouble with them in descending gradients. If the sand gear was in working order, they were rather nice cars to drive.

The Inspector: Are these cars just as easy to keep under control on descending gradients as the light cars?—They get more way on, and once they get away they are harder to stop.

When you descend a steep gradient with the light cars, you can apply the slipper brake before you start?—Yes.

Is that what you generally do on steep gradients?—We do it on Fort Hill.

That gives you a good deal of power?—Yes, it is an additional brake.

With these bogie cars you cannot do that?—We have not a slipper brake on them. We have a skate brake.

You cannot apply that before you descend the hill?—No.

On that account don't you think the light cars are under better control on descending gradients than the heavy ones?—So far as that goes they are.

I don't fancy in descending the hill at Belle Vue Road, that you do apply the slipper brake before starting?—No, sir.

Even if a man is running down the hill with the small cars he does not apply the slipper brake before starting?—No, sir.

At Margate on the steep hill, you do apply it?—Yes.

Mr. Humphries: Do you have any trouble in descending Fort Hill with your bogie cars?—No, sir.

The Inspector: It is perfectly clear if it had been a light car the driver would not have been expected to apply the brake. On the other hand it would have acted as an additional brake.

Mr. Humphries: I don't think an ordinary wooden slipper would act as an emergency brake.

The Inspector: It would act as an additional brake.

Mr. Humphries: It would take so long to apply.

The Inspector: We have these slipper brakes in use all over the kingdom.

Mr. Richard Humphries, resident engineer and local manager, produced the car reports sheets of August 7th, 8th, 9th, 10th and 11th, and no complaint had been entered by motormen using car No. 36 on those days. After the accident he found car 36 was off the road and wedged between car 30 and a column on the footpath on the left-hand side. The front bogie of car 36 had been lifted off the swivel and was at right angles to the truck. All the brake gear was smashed. He then went into the vestibule at the driver's end and found the controller set to reverse. They got the cars back to the depôt as soon as possible, and overhauled them. The only things that he could test were the sand hopper and the sand valve, which apparently was all right. The sand flowed quite freely. There was still sand in the hopper, and the valve was working correctly though the driver's pedal and connecting bar were broken. The brakes were so badly bent that he could not try them. He inspected the controller contacts of the electric brake and found them in good order.

The Inspector: As far as you can judge from the driver Collins's evidence, have you formed any idea as to the cause of the accident?—The only explanation, in my opinion, although it is not formed on the evidence of the driver, for he states to the contrary, is that the hand brake was so applied that as soon as the car shot forward he skidded all the wheels.

Therefore the electric brake was inoperative?—Yes.

What about the track brake?—That would also have been inoperative, but it was not applied until too late.

The Town Clerk: I believe it was a recommendation from Major Pringle that slipper brakes should be affixed to the whole of the cars. May I ask why it was not done?

The Inspector: I don't think you need ask that, I have gone into the matter very fully and shall deal with it in my report. I should like to ask one question with reference to the slipper brakes. The track brakes which you have got on the bogie cars are different from what you have got on the single truck cars. Why cannot you apply similar brakes to the bogie cars?

Mr. Humphries said the application of the brake would not only tend to derail the bogie cars, but they would also get little or no pressure. He explained the working of the brakes used on the bogie cars. Since they had fitted it to their cars the Americans had infringed upon it. The directors went thoroughly into the matter of Major Pringle's recommendation, and came to the conclusion that the ordinary type of slipper brake could not be fitted to the cars in their present condition, the smaller wheels being in front. In answer to the Inspector, Mr. Humphries said there was about 70 per cent. of the weight on the big wheels and about 30 per cent. on the small wheels. If they put a track brake between them the front wheels would fly up off the track, there not being sufficient weight upon them. There would be a derailment on every curve. To apply the ordinary brake they would have to alter all their motors.

The Inspector: So far as the running brake is concerned, I think your brake is a very good one.

Mr. Humphries: The skate acts very well in preventing cars running back. The directors went very carefully into the question at the time of Major Pringle's last report, and as the running back had been the only trouble experienced with bogie cars, they considered the application of this brake sufficient. No set type of slipper brake was asked for. We had to a great extent to use our own judgment and discretion.

The Inspector: There is one question I should like to ask you. This accident has certainly shown there is a danger in bogie cars running down hills. What do you propose to do?—I should have to interview my directors before I could answer that question.

You recognise something will have to be done?—A case like this may never occur again in the running of the line. I did not fit this brake on my own responsibility. The directors went most carefully into the matter.

That little bit of incline is rather dangerous. I am a little surprised to find you have not made it a rule with single truck cars to apply the slipper brake before starting down that hill?—We were running eighteen months before the slipper brake was fitted. That is the reason we have never enforced the regulation.

The weak point about your case with these bogie cars is, if the hand brake is applied so as to skid the wheels, the other two brakes are inoperative?—That also applied to one of the most vaunted brakes on the market—the Westinghouse Magnetic.

Yes; that is so. What it wants is not only the power to act by magnetism, but by hand as well. We have suggested that the Westinghouse brake should be altered so as to make it applicable by hand as well?—We recognise the importance of sanding. We have always made a point of getting our sand right away from Canterbury. We don't trust to sea sand, which clogs. Before the sand is put on any car it goes through a ¼-in. mesh, to prevent any possibility of the sand choking. We also put an emergency bucket on each car, and if the motorman is at all doubtful of his rails, the conductor is sent on ahead of him to sand the rails.

The Inspector: The sanding arrangement appears all right, and there is evidence that the sanding arrangements were in good order at the top of the hill, and there was sand in the box at the bottom of the hill, and, so far as the apparatus could be tested, it appeared to work very well. Therefore, I shall accept that.

The witness Knell was recalled to give evidence as to the position of the controller handles immediately after the accident. He said very soon after the accident he noticed the position of the reversing handle. It was in a position to reverse the current. The controller handle was on the third notch.

Mr. Humphries: It was extremely unfortunate that the trolley left the wire. There was no doubt his trolley pole was off the wire, and therefore his reversing had no effect at all.

The Inspector asked if the town clerk of Ramsgate had any further questions to ask.

The Town Clerk: I think the questions you asked about the the bogie cars are all I wished to raise.

In answer to the Inspector, Mr. Humphries stated that the regulation speed was six miles an hour from the top of the hill

down to Albion Road, and four miles an hour from Albion Road to Victoria Road, and then six miles after that.

The INSPECTOR: I think you had better put a stop on at Albion Road.

Mr. HUMPHRIES: I have already done so.

CORRESPONDENCE.

Automatic Fire Alarms.

I shall be glad if you will allow me space to reply to a letter by Mr. Guarini in your August 7th issue. That gentleman deals with your comments upon the paper read by me at the International Fire Congress last month, and, although I do not think he intends to convey any unfair inference, I think he succeeds in unintentionally doing so. I have no doubt Mr. Siemens will reply to his reflections upon the system described by him, because I know that he can do so very effectively by proving a directly opposite result.

On my own account, however, I have one or two things to set right. Your correspondent speaks of the difficulty of equipping a city like London with a transmitter from every house, &c., to the fire station, and goes on to say by his wireless appliance one receiving set would be sufficient for a city. So it is with our system; and, as far as I know, with every other. Assuming a whole city to be protected, the number of transmitters could be one from each block, or in any other proportion that the engineer entrusted with the installation considered necessary, and, so far as this is concerned, I see no difference between the wireless system advocated and the systems of to-day.

Your correspondent speaks of line interruptions due to atmospheric pressures, snow storms, &c., or alternatively to the heavy cost of underground lines, but this, in practice, is really a negligible quantity. It has been my privilege to protect many millions of pounds' worth of property and to place it in connection with many of the principal fire brigade stations in the kingdom, both by overhead and by underground metallic pairs. Theoretically, we ought to have had trouble with the overhead circuits, and to a reduced extent with the conduit wires as well; but all I can say is, that in practice this does not "pan out" to be the case. Brigade connection by either route has never failed us, and the cost is anything but excessive. My own experience—and I think it is as least as large as that of any other fire alarm engineer in the kingdom—is that the average cost of connection between the protected building and the fire brigade station by a properly insulated metallic circuit (either as an aerial pair or the component part of any underground or overhead cable) is well under £3 per annum; and this includes the cost of maintenance and upkeep. Distance from fire station, average turn-out time of brigades, water supply and pressure, and capacity of appliances, are all taken into account by the experienced engineer, and these practical considerations often oblige him to decline commissions from far outlying buildings or others comparatively close where the brigades are untimely to muster, or their horses, held under retainer, are liable to be absent on other duties when needed. For this reason, automatic fire brigade connections very seldom exceed 1½ miles, and average only about 6 furlongs in length. In some cases our clients prefer both the overhead and underground connection to either of them separately; and when you are protecting an industry of any magnitude, and have put in an automatic installation which runs well into four figures, the £5 or £6 or £10 a year for the maintenance and upkeep of the circuits by each route is a mere bagatelle, and is cheerfully paid by our clients.

I have watched from its inception the developments of wireless telegraphy, and shall be only too glad to adopt it when it has sufficiently proved its reliability, its freedom from miscarriage or interpolation, and the way is clear.

The necessity that a call of fire should reach its destination with absolute certainty and freedom from mutilation will be at once admitted, and if it is possible for any practical joker to interpolate "rats" into a wireless message (as was done on a recent historical occasion), I do not see that it is sufficiently established that a Marconi signal intended for any other destination may not inadvertently stray into and complicate the fire call and send the brigade to one part of the city when they are wanted in another. Another objection, too—and it is existing practical difficulties and not ideal conditions that govern the practice of the engineer—is the repugnance of the brigades themselves to receive unsupported telegraphic signals, which will ensure the retention of the present means of connection for many years. Here and there, one, perhaps, in 100, a brigade station possesses a working electrician, and in this case it may be possible to put in a wireless receiving set. By far the greater number, however, refuse to accept a telegraphic receiver, because there is no one upon their staff who is capable of looking after it, and there is a constant fear that dots will be misread for dashes and *vice versâ*, with the result that the squads will be sent to wrong districts, and that the brigade will be brought into contumely thereby. For this reason, extensive as my experience had been, I am well within the mark in stating that the majority of brigade officers look primarily to the legibly engraved shutter for the message, and only attach secondary importance to the coded bell signal or tape as confirmatory evidence. It is not necessary to moralise as to whether this ought to be the case or not, but I simply state existing facts. The dropping of a shutter by a line contact does not mislead the brigade, because the confirmatory message or coded ring is not forthcoming. Has Mr. Guarini taken this into account?

Another matter your correspondent has possibly overlooked is that in the United Kingdom Parliament has conferred upon H.M. Postmaster-General the absolute monopoly of telegraphic signalling, automatic and otherwise; and it will be necessary for him before he can practice to obtain an abrogation of this privilege so far as fire calls are concerned. This will entail a critical examination of every detail of his system by the experienced and thorough-going engineers of the department; and I think it is extremely unlikely that such a licence will be granted until time has shown that transmission of wireless fire signals will not interfere with wireless commercial telegraphy, or *vice versâ*. I wish your correspondent every success; but he has yet much to do and a long way to go before he can consider his system as practicable commercially. In the end, the matter will resolve itself into a consideration of advantages. The cost of detection and position indication will not enter into this deal, or if it does, it cannot possibly be in favour of the detector your correspondent employs. The crux will be the most economical and reliable method of transmitting the call from the building attacked to the fire station, and this in practice is an utterly unimportant detail, as far as the large industrial concerns who employ the fire alarm engineer are concerned.

Geo. W. Oatway.

49, Queen Street, Glasgow,
August 19th, 1903.

Wanted: A Good Commercial Incandescent Lamp.

"H. H. M." asks in the last issue of the ELECTRICAL REVIEW, "Can any of our lamp makers tell us when we are to get a good commercial incandescent lamp?" If "H. H. M." will kindly communicate with us, we shall be happy to prove to him that the Nernst lamp is the one he is looking for. His objections to it are initial cost, and sensitiveness to change of voltage. With regard to initial cost, we have to say that this is very small indeed, considering the saving in current and further considering that the lamp itself lasts several years. The following example will show this:—A large London business house saved by using Nernst lamps £34 5s., or 31 per cent. of the entire lighting bill in one year, taking all renewals into full account, while a much more extensive illumination was obtained. The alterations and the initial cost of Nernst lamps amounted to £32 4s., at 25 per cent. amortisation (which is ample for every condition), a net saving of £26 4s. per annum, or 24 per cent. remains.

With regard to voltage, this point has been overcome long ago, and we are in a position to refer "H. H. M." to Nernst lamp installations that give perfect satisfaction, and effect a huge saving, although the voltage varies 5 per cent. and more.

The Electrical Co., Ltd.

London, W.C.

Earth Finding.

I send you herewith an account of what I believe to be a new method of localising an earth, which may be of interest and useful to your readers. To find an earth on a plain run of cable, go and return, is easy; Murray's, Varley's and other methods are well known. I prefer Murray's, modified by the use of a slide wire for the ratio arms, but any other will do. To find an earth on a branching circuit, however, is not quite so simple, and I am encouraged to believe that my method is original by the fact that I have just worked it out, after asking all my friends for it in vain. I know that in the old days of house wiring on the tree system, the usual method of finding a fault was by "cutting and trying," and I have known that to be done on distributors in the streets, so some engineers at least must be unaware of the test I will now describe.

Let fig. 1 represent a branching circuit, and F the position of the fault. Now, bridge *any* pair of ends and take a loop test by Murray's or other method. Now, it is obvious that the perfect branches other than the one looped will not be traversed by any current, and will therefore not produce

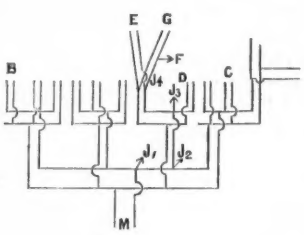


FIG. 1.

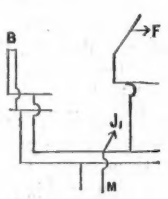


FIG. 2.

any effect. If fortune has favoured you and you have looped the right circuit you find your fault at once; but if not, suppose you have looped at E, then you are testing a loop from the main connection M to B and back, with a fault at the end of a long tapping. Fig. 2 shows this circuit; it is simply fig. 1 with the insignificant wires omitted. Your test shows the fault at the joint marked J_1. Now loop again any pair of wires fed from the joint J_1, not between J_1 and B. Fortune may favour you again; but if not, suppose you bridge the ends at C. The fault will have moved on to J_2. Repeat the process looping at D and E. The apparent position of the fault will move on each time until you locate it at F when looping G. If the fault should be actually at one of the joints it will not appear to move on after you bridge a different pair of ends. Indeed, if at any step in the process you locate the fault twice in the same place with different ends bridged, that is the place. This method saves a lot of trouble and expense in cutting and joining again.

G. C. Knight,
Engineer, Finchley Electric Light Co., Ltd.

The Existence of Ether.

There has been much speculation upon the existence of the ether of space, and it seems reasonable that this hypothetical fluid or body postulated to have the power of transmitting physical sensation, must be at least partially physical, and its existence capable of being demonstrated experimentally in the following manner:—

The apparatus required to consist of a chamber capable of carrying a high vacuum and fitted at the bottom with a delicately adjusted and movable pan connected to a recording pressure indicator fixed external to the chamber; small quantities of an explosive mixture of high power to be fired on the pan under varying atmospheric pressures ranging from normal to high vacuum, and the value of back pressure on pan tabulated in a curve. The theoretical value of back pressure at each point for the inertia of a definite body of gas evolved under the same conditions must now be calculated and the results also tabulated in a curve. I admit that the difficulties in the way of obtaining this theoretical set of readings is enormous, but not beyond mathematics and physics. Although the curves did not coincide, *if they did not run absolutely parallel*, the existence of ether would be demonstrated.

If we speculate that electricity may be ether, electricity, we say, "behaves as if it had inertia." I am very much of the opinion that it will soon be universally admitted that electricity is possessed of real inertia, as the induction theory does not satisfactorily explain the phenomenon that bears that name; hence from speculating that ether may be electricity or *vice versâ* and possess inertia, it would be highly interesting to perform the above experiment in a magnetic field.

George Nairn.

Sutton.

Fiscal Policy.

I have been greatly interested in the discussions which have been caused by Mr. Byng's remarks on Free Trade *v.* Protection. It is indeed a very difficult problem to solve, although, personally, I would very much like to see Protection given a trial. The comment on the printer and his motor does not appeal to one so much as does the fact of local governing bodies going abroad for their machinery. "Let Glasgow Flourish" is the motto of Glasgow, but I fail to see how they can expect to flourish, when, for the sake of a few pounds and perhaps a month or so, they let the contract for the equipment of the largest tramway scheme in Britain to foreign firms, with a few exceptions. I should like to refer to a noteworthy point in connection with Corporation contracts. In the "Contracts" column of this and other electrical journals tenders are invited every week for electrical appliances. Let us take, for example, an Urban District Council and call it X. It advertises thus:—

"The U.D.C. of X invites tenders for steam dynamos, switchboard, &c." Further down it goes on to say that the successful contractor will be bound to pay union or standard wages, observe certain working hours, and so on. This undoubtedly deserves great credit on the part of the U.D.C. of X; but wait a month or so, and in the "Contracts Closed" column you will find that "The U.D.C. of X has accepted the following tenders, viz., ——, of Germany or America, for steam dynamos; ——, of Germany or America, for switchboards," and so on. In short, this well-meaning U.D.C., which, in the first place, showed its eagerness to provide what is just and right for the British workman, has obtained its plant from foreign firms or from British So-and-So, who manufacture abroad, or trade in this country with foreign capital, and mostly foreign labour. How, then, can we expect to bring about Protection when local bodies act in this way. I am of opinion that if municipalities supported home industry, private individuals would follow suit, and the foreigner would be a thing of the *past*.

J. E. Cuthbertson.

Electric Car Drivers.

My training place is the front of a car from the first hour. Each man goes through dummy practice—viz., using controller, pausing, &c., looking at each notch he makes, using handbrake, sand pedal and gong. When I think he has looked at his movements enough, I make him do it without looking at his movements at all; thus he won't want to have his eyes away from the traffic. I also have someone giving signals on bells to the driver, to make him perfect for service. I then ask permission for a little juice. If the shed road is at all suitable, I run each man up and down there. Each man has been shown all of the chief working parts of car—switches, main fuse, earth lamps, sanding, braking arrangements, &c. Then I disable a car, disconnect a handbrake and one or two parts and let the men remedy this; I also let them do all necessary repairs which are likely to happen on the road. I take the school car out on the loneliest part of the road, working each man first on series, and afterwards on parallel. I endeavour to get what I term surprise packets—viz., someone gets to the front of the car suddenly and watches the driver's actions. I know that my men are not so bad, because two or three towns have had their insurance scale lessened on account of absence of serious accidents. I hope some manager who has had a fair number of railway men will see my remarks and give his ideas. I draw the managers' atten-

tion to age: the oldest hand I have trained is 30 years. The railway wages average 24s. to 28s. for firemen; guards, 21s. to 29s. and 30s. I fail to see where the wages are insufficient, especially as the men would always be at home, not lodging away as railway men do. Discipline is as important on a railway as on a tramway. I am only an instructor, and I teach whatever class of men comes; of course I give the manager a true account of each man, and that ends the matter.

Driver Quick-Stop.

Switchboard Attendants are Cheap To-day!

As an interested reader of the ELECTRICAL REVIEW, I noticed in your last issue, under the heading of "Situations Vacant," an advertisement which I enclose:—

"SWITCHBOARD Attendant wanted in a combined lighting and traction station. Nominal salary (10s. per week).—Apply, giving full particulars of experience and enclosing testimonials, to 3509, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 3509"

Being a switchboard attendant myself, I must say that I felt somewhat disgusted to think anyone would have the audacity to offer such (as it is called) a nominal salary as 10s. per week.

To what is the trade coming? I think we want a trade protection scheme for the electrical trade, especially with regard to salaries. I don't object to competition, far from it, but when it comes to 10s. per week, which is less than a school boy would get when first starting in commercial life, I think it one's duty to draw attention to these things. Perhaps the advertiser will tell us how to live and what to live on, so as not to exceed his nominal salary.

10,000 Volts.

August 6th, 1903.

Underground Railways and Fire.

There has been considerable correspondence in the Press relating to the fire on the Metropolitan Railway of Paris, discussing causes and means of preventing like catastrophes on our own tube railways.

One is pleased to learn that on the Metropolitan and District Railways "everything is to be fireproof;" that the Central London are "going to put in independent lighting circuits," &c., to ensure safety from fire, and the equally serious risk from panic among passengers suddenly plunged into utter darkness.

There is one point which I consider has not been sufficiently emphasised. It is a comparatively simple matter to completely isolate the motor from the passenger-carrying portion of the car; the great danger arises where a fusion of the lighting-circuit conductors occur, buried as they are out of sight, and likely at such a time to set alight any woodwork surrounding them. Even if run in steel or iron tubing, the danger is still there, though not to the same degree. The only absolutely safe method is to run the lighting circuits in insulated steel tube with fireproof fittings.

This applies equally to tunnel and station lighting, and had the Paris tunnels and stations been so fitted, there would have been no such failure of light, with the consequent panic and loss of life.

The Central London Railway is fitted with this insulated conduit system, the lamps burning five in series on duplicate 500 volts circuits, positive conductors inside one conduit and negative in another. I believe this system has never yet, on the Central London Railway, been at fault. Moreover, just before the opening of the line a most serious fire occurred at the Bank Station, through workmen carelessly throwing matches into inflammable rubbish.

The corridors were raging furnaces, but the Fire Brigade were able throughout to work by the light of the electric lamps installed, not one of which failed.

So fierce had been the flames that the steel tubing had become red hot, and when afterwards it was taken down for examination, it was found that the whole of the insulation of the conductors had melted, and amalgamated with the insulation of the conduits, leaving the interior of the tubing a solid mass of insulation, through the centre of which ran the conductors uninjured.

This incident is one too little known, and though the insulated conduit may be more expensive than plain tubing, its factor of safety is so much greater, that our railway engineers should be slow to disregard it.

Electromotive.

Electric Rock Drills.

With reference to the article on electric rock drills in the current issue of the ELECTRICAL REVIEW, we beg to inform you that we are now putting on the market an electric rock drill of British manufacture.

We are manufacturing the "Marvin Sandycroft" drill, which is of the solenoid type, and with regard to the question of upkeep may say that it is reduced to a minimum, the cost of repairs being much less than would be the case with an air drill doing the same work.

The blow struck by this drill is as heavy as that struck by an air drill of comparable size, and on tests on the rock it has been shown that for the same amount of drilling the energy required by our electric drill is less than half that consumed by an air drill of the best type.

The drill will effectually deal with the hardest rock, and owing to the fall of back E.M.F. a great effort is available in the event of the drill sticking in the hole. We have recently installed several of these drills in the Buxton district, and they have given complete satisfaction.

It should not be claimed for an electric drill that it is the most suitable one for all classes of work; but we are firmly convinced that, given thoroughly sound construction, there is a splendid field for it.

Its installation is simple, and the greatest flexibility is obtained at the same time. The whole plant can be handled and successfully worked by unskilled labourers.

The Sandycroft Foundry Co., Ltd.
H. F. G.

Chester, *August 19th*, 1903.

Trade Marks.

We have read with interest your article on "Trade Marks and Trade Names" in your current issue, and wish to endorse all you say about the need of more modern and efficient classification than at present exists. There is probably no branch of industry where trade marks are more numerous or of greater importance than in the soap trade, and at present, to protect a word or device effectively for soap alone, it is necessary to register in no less than four separate classes, viz., Nos. 2, 3, 47 and 48.

Ordinary soap comes under Class 47.

Toilet soap is placed with perfumery in Class 48.

Medicated soap comes in Class 3, "Chemical substances prepared for use in medicine and pharmacy."

Whilst disinfectant soaps are included under Class 2, "Chemical substances used for agricultural, horticultural, veterinary and sanitary purposes."

Josh. Crosfield & Sons, Ltd.

Warrington, *August 21st*, 1903.

Hot-Wire Arc Lamps.

As a user of arc lamps for some years, I trust you will allow me space for a few remarks in your "Correspondence" columns.

A letter signed "Enclosed" has been shown me by my engineer, and, in justice to Messrs. Foster & Co., I beg to say that I have had some dozen or more of their lamps for over four months, and not one of them has ever pumped, or done anything in any way to reduce the very high opinion which I hold of the "Foster" lamp.

"Enclosed's" letter is, to say the least of it, a perversion of the truth, and knowing the lamp as I do, I am annoyed it should have been written. I conclude that your correspondent has some interest that "Foster & Co.'s" success is threatening.

I am not an electrician, but a user. I want the best lamp on the market, and do not care who makes it. I only speak of these lamps as I find them, and fully believe I have the best both for light and current bill.

Fair Play.

P.S.—I gave up my other make of lamp in favour of the "Foster" owing to the trouble I continually had with the dashpots.

We have read three letters in your valued "Correspondence" columns of the current issue, and would take it as a favour to be allowed space for a few remarks on same.

"J. G." states a case of actual demand for change-over lamps, and we can assure you that there have been many others; we are now executing similar orders. The value of change-over lamps to central station engineers who contemplate a change from one supply to the other, will be obvious to them at least, if it be not to the partisans of the dash-pot.

Turning with pleasure to the courteous letter of "F. J. T.," we note that he deals with the matter as an engineer and man of business who is receptive to improvements in his profession, and keeps an open unbiassed mind, but is willing to learn.

As regards his query (*a*) we anticipated this question of variable temperatures several years ago, and find that the design of the lamp and the materials used therein are ample compensation for the biggest temperature difference that can arise.

Query (*b*). We do not see why hot-wire lamps should not be controlled from some central point; but the system is now so little in vogue that we do not expect to be asked to meet these conditions.

"Enclosed" must please not try to fasten on us any excuse for his letter; we would rather he retained the entire responsibility for same, such as it is. We cannot waste your valuable time and ours in replying to the personal and other competition-inspired statements of this letter, and have no objection to his retaining his dash-pot as long as he likes.

Meanwhile, we have no need for this rightly "much-abused piece of mechanism," and save the cost of it for ourselves and customers.

We needly hardly say that all arc lamps, if improperly adjusted or tampered with, will pump, and that the pumping will be "chronic" if not attended to.

As regards the case of pumping "Enclosed" refers to, we can only say that we have had no complaints, as would have been the case if the lamp had been purchased for legitimate purposes, and that he could have stopped the pumping in five minutes, or less, by means of a small spanner, and the simple instructions sent with the lamp.

If "Enclosed" will place the lamp in trustworthy and independent hands, we will undertake to put it right immediately, and we should also like to see what it was like since leaving the factory *properly adjusted*.

As regards the live case, this is now common practice; but we can and will insulate same as required. The remarks on arc voltage suggest to us ignorance of the whole subject.

We have had no trouble with sticking of the top carbon, and do not anticipate any, having amply provided for this trouble which is common with all lamps.

There is very little difference between normal and feeding currents, this, also, having been properly arranged, as any competent engineer can see for himself in the usual way.

Foster & Co.

I do not know who "J. G." is, but he made an unwarrantable use of my name in a letter in your columns last week. He alone is responsible for any statement contained therein, and for any conclusions your readers may gather from its context.

V. A. Mundella.

Northern Polytechnic Institute,
Holloway, London, N.,
August 25th, 1903.

In reply to Messrs. Foster & Co's. letter which appeared in your issue of August 14th, I beg to point out to the writers that the fact of their calling down abuse on my head does not in any way help forward the matter under discussion, and is to say the least of it undignified. I note that Messrs. Foster & Co. admit that the resistance of the lamp as stated by Mr. Tomlinson-Lee *was not intended to be correct*, but they do not give figures as to what their lamp resistance really is, neither do they state the maximum temperature variation of that resistance. As this has an important bearing on the behaviour of lamps in series, it would throw considerable light on the question if these figures were given, and would be of more value to your readers than abuse of the writer. To support this, let us refer to Mr. Tomlinson-Lee's article in which he claims that *the strip is the soul of the lamp*, and in another paragraph asserts that *the strip will carry three times the striking current without deterioration*. Now, if we assume (while awaiting Messrs. Foster's figures) that the lamp resistance is, as it is stated to be, 2 ohms or thereabouts, we get with three lamps in series on a 240-volt circuit a striking current of 40 amperes. Doubtless Messrs. Foster & Co. would like us to believe that a wire capable of appreciable elongation when a current of 5 amperes is passing will not be damaged by 120 amperes, or is this another passing statement? The fact that I only accounted for 1 per cent. of the arc lamps made (by probably the best English maker) failing, ought to need no explanation to those having dealings with arc lamps. As Messrs. Foster & Co. are doubtless aware, electrical apparatus will not last for ever, and failures are bound to come sooner or later, otherwise we should have none of the depreciation fund troubles that exist in many municipalities. Therefore, the vast unknown 99 per cent., of which I make no mention in my previous letter, leave the works of the manufacturers in question and never return there. Some, of course, do fail, and are delicately adjusted again by the trimmer or other skilled attendant, but the great majority run for years and, if necessary, I can give the names of several towns where arc lamps of the despised solenoid type have given, for over ten years, and are still continuing to give, entire satisfaction. I am afraid the hot-wire lamp makers are under a big delusion when they state that they do not require the enormous amount of insulation common to the solenoid lamp. They need only look up a few of the recent specifications issued by our leading consulting engineers to find that in every case they insist on a lamp with its frame insulated from all live parts, and it is scarcely conducive to a large sale to fly in the face of such authority and accepted practice. I would remind Messrs. Foster & Co. that in my previous letter I denied Mr. Tomlinson-Lee's statement that a dash-pot could not be made dust-proof, and no amount of quibbling can lead one away from the fact that in all English lamps of repute the dash-pot is either practically dust-tight or designed in such a way as to render the accumulation of dust impossible. If they will take the trouble to look at lamps erected within the last three years they will find that this is so. Messrs. Foster and Co. cite Manchester as a town where arc lamps have come into disfavour, but they do not state the why and wherefore, the maker of the lamp, or the number of councillors interested in the gas company, neither do they state that the Foster lamp has caused a re-action in favour of arc lighting in that district, and unless one knows all the facts of the case, it is useless to point to one solitary town as proof of an obviously biassed statement. It would be extremely interesting to know on what grounds the patentees claim that the best results are obtained with alternating currents. Solenoid lamps usually run on alternating current circuits with no resistance in series at all. Now, how can a hot-wire lamp, having a high and fluctuating mechanism resistance (2 ohms or thereabouts) compare in efficiency with other lamps running without any resistance loss whatever. Are we to infer that by some hitherto unknown phenomena the use of a hot strip for governing the mechanism of an arc lamp effects a mysterious back E.M.F. in some manner, thus producing the wonderful efficiency claimed by Messrs. Foster & Co., or is this another statement not intended to be taken seriously? In conclusion, I am firmly convinced that the principle of hot-wire regulation is bad, and at the best can only have a very limited field, since

it is impossible to run arcs controlled by hot wires on a constant current or long series circuit. I might add that my card is at the service of Mr. Tomlinson-Lee, but for obvious reasons, I have no wish to have my name published.

N. D. W.

BUSINESS NOTES.

Electrical Wares Exported.

Week ending Aug 25th, 1902.		Week ending Aug. 25th, 1903.	
Adelaide	Value £233	Alexandria	Value £164
Aden. Teleg. mat.	173	Amsterdam	65
Amsterdam	65	Antwerp	240
Antwerp	42	Auckland	210
Auckland	67	,, Elec. fuse	70
Bombay	265	Bahia	40
,, Teleg. wire	511	Bombay	65
Buenos Ayres	152	Bremen	21
Calcutta	939	Brisbane	80
,, Teleg. wire	2,475	Buenos Ayres	126
Cape Town. Teleg. wire ..	1,150	Calcutta	89
Chinde	21	Cape Town	1,044
Colombo	53	Channel Islands	55
,, Teleg. mat.	110	Chemulpo	90
Copenhagen	66	Colombo	80
,, Elec. cable ..	428	Durban	4,088
,, Teleg. wire ..	83	Fremantle	474
Durban	810	Gothenburg. Teleg. mat. ..	42
,, Teleg. mat.	865	Hong Kong	43
Ghent	35	Madras	201
Gibraltar	20	Melbourne	40
Larache	101	,, 9 tons Teleg. wire .	—
Madras	69	New York	25
New York	25	North Atlantic. 81 knots Teleg. cable	—
Perth	295	Otago	128
Port Elizabeth	154	Perth	178
Shanghai	22	Port Elizabeth	351
Singapore. Teleg. cable	73	,, Teleg. mat. ..	1,851
Sydney	189	Rosario	84
Wellington	310	Shanghai	298
Yokohama	339	Stockholm	21
		,, Teleg. mat.	25
		Sydney	3,068
		,, Teleg. mat.	898
		Yokohama	49
Total ..	£10,060	Total ..	£14,215

Foreign Goods Transhipped.

Durban. Teleg. wire ..	Value £147	Otago. Telephones. ..	Value £45
Shanghai. 116 lds. Teleg. poles	—		
Total ..	£147		

Books Received.—"Technical Education": Return showing application of funds by local authorities during the year 1901-1902. Published by order of the House of Commons, by Messrs. Eyre & Spottiswoode. 1s. 3d. The total amount expended on technical education (including science, technical and manual instruction) is stated as £1,008,948 for England, and £48,451 for Wales = £1,057,399. The County of London stands at £152,632.

"Jahrbuch des Schweizerischen Elektrotechnischen Vereins." 1902. Zurich: Buchruckwei Jacques Bollmann.

"Beginner's Manual of Submarine Cable and Testing Work," by G M. Baines. London: The *Electrician* Printing and Publishing Co., Ltd. 7s. 6d. net.

"The Practical Physics of the Modern Steam Boiler," by Frederick J. Rowan. London: P. S. King & Son. 1903. 21s. net.

"Year Book of the Armour Institute of Technology, Chicago, for 1903-04" Chicago: Armour Institute of Technology Press.

"Technical Education (Application of Funds by Local Authorities) during the year 1901-2." London: Eyre & Spottiswoode. 1903. 1s. 3d.

"Science Abstracts," No. 67, July 25th, 1903. (A.—Physics; B.—Engineering.) London: The Feilden Publishing Co, Ltd. 1s 6d. each.

"The Actinolite for the Treatment of Disease by Actinic Light." Second edition. New York: Kliegl Bros.

"Index of the Technical Press." No. 5, August. Brussels: Association de la Presse Technique.

Chelsea Polytechnic.—The new session at the South-Western Polytechnic, Manresa Road, Chelsea, commences on September 23rd, the entrance examination taking place on September 21st. Particulars as to courses and fees are briefly given in our educational advertisements to-day.

Newfoundland.—Under the new tariff the import duty of electric motors imported into Newfoundland has been fixed at 25 per cent. *ad valorem*.

India.—*Indian Engineering* says that Messrs. Marshall, Sons & Co., of Gainsborough, Calcutta and Bombay, have entered into a combination with Messrs. R. E. Crompton & Co., Ltd., of Chelmsford, to facilitate the obtaining of electrical installation business in India.

Electrical Machinery Exports.—The value of the electrical machinery exported from this country during July last amounted to £34,683, bringing up the total for the first seven months of the year to £258,807.

Catalogues and Lists.—Messrs. Siemens Bros. and Co., Ltd, have sent us two of their new pamphlets. No. 7 contains an interesting account of the Siemens-Brougham electric steering and controlling gear. The gear used on the steam yacht *Valhalla* has already been described in the company's No. 5 pamphlet; the present publication has a view of that apparatus, and also some other excellent half-tone pictures, as well as clear diagrams of connections. In pamphlet No. 8 some remarks on rectified currents are followed with a description of Koch's system of rectifiers for transforming alternating into direct currents. Several classes of apparatus for battery charging are shown and detailed, and others for X ray work. Both of the pamphlets are got up in the excellent manner which has characterised all of Siemens's recently issued lists.

The Simplex Steel Conduit Co., Ltd., has just issued an abridged price list, which is made of additional value by being bound up with a reprint of the new wiring rules of the Institution of Electrical Engineers, for which special permission was obtained. The price list is an abridgment of, or can be used in conjunction with, the company's 1903 catalogue (200 pp.), the edition of which, although only issued in March last, has been almost exhausted owing to the many calls that were made for copies. The prices in the abstract are given in a condensed form, with illustrations of reduced size. Two additional types of conduit are now listed to meet special cases — viz., Simplex "Wireduct," and "Solid-drawn" conduits. Any of our readers who, not having received the current price list, are anxious to have "Simplex" current prices stated in condensed form, either for office or foremen's use, can obtain copies upon application at the general manager's office, Westinghouse Building, Norfolk Street, W.C.

A new illustrated pamphlet of the Nernst lamps, with prices, &c., has been issued from the office of the Electrical Co., Ltd, of Charing Cross Road, W.C.

The B.T.H. Co.'s pamphlet No. 149 particularises their adhesive insulation tapes, and No. 75, which we have also received, gives August prices for slow and moderate speed continuous-current shunt-wound motors of the DA type.

From the Submerged Electric Motor Co., of Wisconsin, U.S.A., we have received copies of their new bulletins Nos. 1 and 7. No. 1 contains a very full account of their submerged electric boat propellor which is made for speeds of from four to six miles an hour, to run from 20 to 70 miles on one charge of battery, and weighs from 120 to 350 lbs. each equipment. The motor is enclosed in a spherical case, and the propeller blades are mounted direct upon the armature shaft; the switch or controller is contained within the small ball at the top of the tubular stem, and is provided with an outside lever. The apparatus occupies the place of the rudder on the stern of a row or sail boat, to propel and steer it. The list also contains illustrated details of generators for charging batteries. Bulletin No. 7 describes at length, with many pictures, an improved electro-dynamic equipment for lecture table and laboratory work in technical schools and colleges.

From the Land and Sea Cable Works Ltd., of Nippes-Cologne (27, Mincing Lane, E.C.), we have received a set of price lists, printed in German, giving particulars of their various manufactures. The lists detail their single-core, concentric, bi-concentric, twisted twin, three-core and four-core cables for any working tension up to 12,000 volts, and higher, if required, of the fibre-paper insulated type; high tension cables specially designed for pits and mines; lighting wires of all descriptions, cables for workshop lamps, connecting cables for engine plants, and cables with non-inflammable coverings; india-rubber-covered cables for all required grades; telephone and telegraph cables, paper, fibre and rubber-insulated gutta-percha-covered submarine cables; plain and covered copper wires of all kinds. Among the accessories shown are distributing boxes in which all the fuses are arranged on the same level, and are therefore easily accessible, and their patent terminal boxes for high-tension cables.

Messrs. Holden & Brooke, Ltd., of West Gorton, have brought out two new lists. No. 37 (28 pp.) gives much descriptive and other data respecting the well-known "Sirius" boiler-feeding injectors. Illustrations are given of the "S" one movement self-acting type, and other different patterns, and some serviceable tables of capacities, working pressures, feed water temperatures, standard deliveries, &c., are published. No. 39 deals briefly with non-lifting injectors for low-pressure boilers.

Messrs. Waltham & Co. have sent us several sheets showing some of their designs of artistic metal work in forged iron, brass and copper, for electric pendants, lanterns and brackets. These and many other examples of their high class metal work, may be seen at the firm's showrooms in York Street, Buckingham Gate, S.W. An accompanying sheet gives prices of the various fittings illustrated in the lists.

Blast Furnace Gas Engines.—The blast furnace gas-driven blowing engine which the Blast Furnace Power Syndicate, Ltd., supplied to the Clay Cross Co., Chesterfield, has been in constant work blowing the furnaces during several months with very satisfactory results. The final adjustment of the air valves in the blowing cylinder have under this period of trial proved most successful. The apparatus supplied by the syndicate on their patented principle cleanses the gas from dust and tar in a highly efficient manner. A similar gas treatment plant which the syndicate are putting down at the Yorkshire Iron Co.'s works, Ardsley, is progressing rapidly. The Sheepbridge installation of two engines driving the entire electric generating plant has been in successful operation now for some years, so that the system is proved efficient and reliable over a period of time that should satisfy the most exacting.

The Transvaal.—The value of the electric cable wire and fittings imported into the Transvaal during the five months ending with May last, is returned at £25,000, as compared with only £13,000 in the corresponding five months of 1902.

Annual Outing.—On Saturday last a large number of the employés engaged in the various departments at the Gillingham Street works of the Sir Hiram Maxim Electrical and Engineering Co., Ltd., journeyed by train to Clacton-on-Sea, the occasion being their annual outing. Sir Hiram Maxim invited the whole of the employés to dinner at Day's Hotel, and again in the afternoon the company met for tea, after which Mr. A. W. Hill, works manager, said that by the help of all present the company had built up a reputation for the quality of their manufactures second to none, and he trusted that with their continued help, next year would still see them advancing. Cheers were given for Sir Hiram and Lady Maxim and the directors.

Liquidation.—The Electric Lighting and Fittings Corporation at a meeting held at Liverpool on August 18th resolved to wind up voluntarily. Mr. Simon Jude is liquidator.

Whitley's Patent Hack Saw.—Messrs. Beanland, Perkin & Co., of School Close Works, Leeds, are just placing upon the market a new double hack saw, which has two saws working alternate strokes, reducing the time required for cutting off girder sections by one-half. It is provided with a planed slotted table, on which any section can be bolted, and will cut at any angle. It has an attachment for ensuring that the blades shall be put in straight, and it is said that in cutting a 12 in. × 5 in. girder, the blades will not deviate $\frac{1}{32}$ in. Its arrangement is such that one of the bows on reaching the centre of the cut is pushed back sufficiently to allow the other bow to come through and complete the cut. Each bow is drawn forward independently by a chain with adjustable weights, and the feed can thus be suited to the keenness of the blade and the material being sawn. The chains can be unhooked and the bows at once thrown back to put in or remove the work. The saving in time occupied in cutting off girders, &c., is claimed to make the machines almost as speedy as heavy circular saws costing three or four times as much.

The Markets of the World.—In consequence of the increased attention which has been given lately by all classes of the community to commercial matters, and more especially to the position of affairs in countries that are our chief competitors, *Commercial Intelligence* has published the more important of its Consular and Commercial maps which have appeared from time to time in *Commercial Intelligence* in separate form. We have received a copy of this publication which is entitled "The Markets of the World." It includes maps of the United States, Germany, France, Russia, Italy, Austria, The Balkan Peninsular, and Denmark. In addition to the large amount of commercial information in the maps themselves, showing where the chief products of the country originate, navigable rivers, &c., there are flags to indicate where British and American Consuls respectively are situated, and the division of the trade of each country with other nations is given in a diagrammatic form. The collection is published at 6d.

Lazarus v. National Telephone Co.—In the City of London Court, on the 19th inst., Judge Lumley Smith, K.C., delivered a considered judgment in an action brought by Mr. Henry Lazarus, of the Hermitage, Bushey Heath, against the National Telephone Co. for damages for wrongfully cutting off his telephone service. According to the plaintiff's case, three years ago he became a subscriber to the defendants' service for one year, and paid a fixed rent-charge of £3 10s. a year. The arrangement had gone on from year to year, but last month, five days before the next payment was due, the defendant company required him not only to pay the £3 10s., but 30s. in addition for calls, and to sign a fresh contract. At first he refused to pay the 30s., but afterwards sent a cheque for £5, and declined to sign the fresh contract. His cheque was returned and the service disconnected. He now claimed damages for the inconvenience to which he was subjected. The defendants case was that at the end of every year they had the power to say whether any agreement should be continued or not. The company found that the original method of payment adopted did not pay, and they demanded a *minimum* payment of 30s. for calls, instead of a penny per call—the old arrangement. Judge Lumley Smith, in giving judgment for the defendants, said in his opinion the approval of the Telephone Co. was requisite at the commencement of each year to enable the hiring to continue. The defendants did not approve of a continuance after the third year, and were not bound to continue. No notice was stipulated for, but the Telephone Co. might reasonably have given the plaintiff more than a few days' notice. The action failed, but he would give leave to appeal. As the legal aspect was doubtful, it was only fair that he should order each party to pay their own costs.

National Telephone Co. v. Williamson.—Plaintiffs sued the defendant at the Glasgow Sheriff Court for £3, being the balance of rental at the rate of 2d. per day in connection with a party line circuit. The defender declined to pay on the ground that no proper workable instrument had been supplied, so that the telephone was practically of no use. The Telephone Co., however, brought witnesses to show that no complaints in writing had been made, and that the telephone had actually been used to a greater extent towards the end of defender's tenancy. His Lordship gave decree, with expenses, and said that if defender had proved his allegation, he would have been inclined to give effect to it, but such a defence required to be made out by clear evidence.

Trade Announcement.—Messrs. Hall & Blacklock, electrical engineers, have taken new offices at 190, London Road, North, Lowestoft, and all future communications should be sent to that address.

Russia.—Mr. Consul-General J. Michell in his report on the trade of St. Petersburg for 1902, says that the German competition in electric lamps by diminishing price and reducing quality had almost ruined the trade. The lamp mostly in use is the Edison with a screw socket and the voltage 110. Native production is exceedingly small. Electric machinery, both for technical and medical purposes, offers, continues the Consul-General, a promising field in Russia. This was well appreciated by large German and Austro-Hungarian electric firms, which have established branches here. The names of British makers remain almost unknown to Russian purchasers.

Mr. Consul H. M. Grove in his report on the trade of Moscow for 1902, says that there will be, and to a certain extent is, a great field for all electrical appliances. There are already fully 30 German electrical societies in Russia, and about 80 per cent. of all electrical plant in use comes from Germany. In Moscow the tram system is now in process of conversion to electric traction, a large undertaking that will not take less than five years to accomplish; and this has already been, or is being done, in various other towns. The total length of lines in the Moscow scheme will be about 125 miles. The trolley system has been adopted, and the probable cost will not be less than £4,200,000.

The Compagnie Centrale d'Electricité de Moscou reports a loss of £25,818 for the last financial year.

ELECTRIC LIGHT AND POWER NOTES.

Ashington.—The Council has accepted the offer of the Northern Electric Supply Co. for the supply of electric light in the district.

Brighton.—The L.G.B. has sanctioned the borrowing by the Council of a sum of £550 for a period of 10 years, for electrical purposes.

Burnley.—The report of the electrical engineer for the year ending March 31st, states that the results for the year's working were as follows:—Units sold for lighting, 375,769, against 331,853 last year, 13·23 per cent. increase; units for motors, 26,475, against 16,617, 59·32 per cent. increase; and traction, 891,079, against 151,445 (December, 1901, to March, 1902); or totals of 1,293,323 and 499,915. The equivalent of 8-c.p. lamps connected, excluding tramway motors, has increased from 28,538 to 31,995, or 12·1 per cent. The profit on capital expenditure (without interest and sinking fund) was 10 3 per cent. The interest and sinking fund on capital expenditure was 5·6 per cent., leaving the net profit on the year equal to 4·7 per cent.

Cape Colony.—The Graaff-Reinet Council has decided to call for tenders for a scheme of electric lighting and pumping water for domestic purposes.

Clydebank.—The recent meeting of the T.C. to discuss the issuing of a plebiscite paper to the electors on the question as to whether the burgh should or should not carry out its own electric light provisional order, was somewhat stormy in tone between the active supporters of municipalism and private trading. A letter was read from the Amalgamated Wards' Committee requesting that on the plebiscite paper the question be simply asked whether the ratepayers were in favour of the Council proceeding with the order or not. Against this proposal an amendment was put that there be also added some facts and figures, showing what had been done by other burghs of similar size to Clydebank which had municipalised the electric light supply. This led to a warm discussion. Ultimately the amendment was carried by an overwhelming majority, and it was remitted to the magistrates to prepare the plebiscite papers.

Devizes.—The Town Council has resolved to apply to the Local Government Board for a provisional order for supplying electricity. They have also resolved to engage an expert engineer to prepare a scheme and advise the Council.

Dublin.—The Lighting Committee announces that the preliminary working and testing of the new electric supply system are in progress. During the preliminary operations energy will be delivered to the new mains each evening from 6 o'clock till midnight, and it is added that any consumer connected to the new system prior to September 1st next will have the privilege of using the supply free of charge up to that date.

Falkirk.—The Electric Lighting Committee has resolved to recommend that the price of electricity for lighting purposes be reduced from 6d. to 4½d. per unit. The price for motive power will remain unaltered at 2d. per unit. The lighting

scheme has met with more encouragement than the Committee anticipated. It was estimated that at the end of 12 months there would be 6,000 8-c.p. lamps in use. The works were opened at the beginning of March, and up to date the number of lamps in use is 4,669, while the applications represent 6,160 8-c.p. lamps. Thus the estimate has been all but reached within six months. The popularity of the light has led the Committee to make the recommendation to reduce the rate, and it is anticipated that during the coming winter the number of consumers will be greatly augmented. Unfortunately, however, there have been very few applications for energy for motive power, and an effort is to be made to popularise this side of the scheme.

Grimsby.—The Great Central Railway Co. has decided to illuminate the fish pontoon by electricity. Instead of purchasing it from the Corporation, however, the company is generating it at its own power station near the Graving Dock.

Huddersfield.—The borough electrical engineer has received instructions to submit plans and estimates to the Electricity Committee of the Corporation for supplying electricity within the urban district of Linthwaite, which adjoins the borough. The provisional order required for the purpose has received the Royal assent. An application is to be made to the Local Government Board for sanction to borrow £7,500—the estimated cost of the works.

Limerick.—The L.G.B. has sanctioned a further loan of £7,000 to the Corporation for the purpose of extending the operations of the Limerick electric lighting scheme.

London.—Shortly after 5 p.m. on the 24th inst., a steam pipe exploded at the Kensington central electric lighting station, which is situated close to the West Brompton Station of the District Railway. The occurrence caused great alarm among the people of the neighbourhood, and a crowd collected round the gates of the station. The officials announced that no one had been injured, and that the damage done was only slight.

Londonderry.—The Corporation has adopted a resolution drawing the attention of the Lord Lieutenant of Ireland to the action of the Board of Works in refusing to sanction a loan for the carrying out of the private electric lighting scheme, when it had previously sanctioned £7,000 to Limerick for the same purpose.

Mansfield.—Col. W. L. Coke has held an inquiry regarding an application by the Town Council for the consent of the L.G.B. to appropriate and use certain lands acquired by the Corporation for various purposes, including a depôt for the electricity undertaking. Mr. Spencer Hawes, M.I.E.E., member of the firm of Messrs. Robert Hammond & Son, the consulting engineers, gave evidence as to the suitability of the land as allocated for the purposes of the electricity supply and refuse destructor. No objection was made to the various proposals.

Mansfield Woodhouse.—The Urban District Council is negotiating with the Mansfield Town Council for a supply of electricity for public lighting purposes within the Urban Council's district.

Mexico.—Negotiations are proceeding between the Mexican Light and Power Co. and the Siemens & Halske Co., in Mexico, with a view to the fusion of the undertakings. The latter enjoys important privileges in Mexico, especially a monopoly of the electric lighting of the city and the supply of power to the works. The new Mexican company, which was formed a short time ago, proposes to utilise the water power of the Nekaxa River for the generation of electrical energy, and would be able to supply consumers in Mexico at cheaper prices than the Siemens & Halske Co., which employs steam engines. The negotiations aim at a fusion of the two enterprises in such a manner that the Siemens & Halske steam-driven plant would be shut down, and the supply of energy obtained directly from the Mexican company.

Norton.—The Urban District Council met specially to consider the question of the lighting of the town for the next three years. The Northern Counties Electricity Supply Co., who have obtained an order of the Board of Trade for lighting the town, not yet having taken practical steps for carrying out that order, the Council was again thrown upon the resources of the gas company, and their three years' tender was accepted.

Pontypridd.—The revised estimate of Mr. R. P. Wilson, the electrical engineer to the District Council, shows a decrease of £18,814 in the price contained in the original tenders in connection with the electricity and refuse destructor scheme. £3,450 is allowed for contingencies.

Rosario.—An exchange says that the new station of the Rosario Electric Co. was inaugurated at the end of July.

South Shields.—The Electrical Committee has had under consideration the question of disposing of the profits of the electric lighting undertaking for the last financial year. After meeting all current expenses and payments in respect of capital and interest the balance left in hand was £1,100. It is suggested that of this sum £800 should be placed to the credit of the rates and £200 to reserve fund, while the remaining £100 is carried forward. The reserve fund will be increased from £2,300 to £2,500.

Rhodesia.—At a special meeting of the Mafeking Town Council it was decided to light the town by electricity, the power to be generated by oil engines. A public meeting will be called to sanction a loan of £6,000 for this purpose.

ELECTRIC TRACTION NOTES.

Bath.—The Light Railway Commissioners have submitted to the B. of T. for confirmation the Bath Electric Tramways (Light Railways Extensions) Order of the Bath Electric Tramways, Ltd. Objections to the confirmation should be lodged at the Railway Department of the B. of T. by September 3rd.

Birmingham.—It is proposed when laying down the new lines for electric traction that an extension should be made from Shirley through Acork's Green, Yardley and Stechford to Aston. A start has been made in connection with the electrification scheme. Much dissatisfaction is expressed locally at the Corporation buying Belgian rails.

Bolton.—As the cost of an electric tramway to Darcy Lever would have been too great for the outlay to be remunerative, the Bolton Corporation is establishing a motor omnibus service to that small suburb by way of experiment.

Burton-on-Trent.—The first two weeks' running of the electric cars were quite beyond the expectations of the management. For the week ended August 8th, 93,695 passengers were carried by 9 to 10 cars, producing £493; the following week the passengers numbered 93,938, carried by 12 cars, and the receipts were again £493.

Burma.—Mandalay is going ahead with its electric tramway line, and, it is hoped, will be running cars before the end of the year. The Municipality hopes soon to introduce electric lighting.—*Indian Engineering.*

Bury.—The T.C. last week considered a proposal to require the Bury, Rochdale and Oldham Tramways Co. to sell to the Corporation those portions of their undertaking, within the borough, which were authorised by the extension order of 1882. The requisite notices with regard to such portions as were constructed under the Act of 1881 had already been given. It was stated that all the local authorities interested are acting in concert. The resolution was adopted.

Dewsbury.—The Corporation, the Ossett Corporation and the Soothill Nether District Council have decided to make applications for powers to construct electric tramways within their respective areas. Some time ago an application was made by the Wakefield and District Light Railway Co. for an order to construct a line from Dewsbury through Soothill Nether and Ossett and on to Wakefield, but the application failed. The idea now is for the authorities named to jointly construct a line from Dewsbury to Ossett. Soothill Upper District Council has asked to be included in the scheme, but the representatives of Dewsbury, Ossett and Soothill Nether have decided not to entertain this application at present, as with the first scheme they think they have sufficient on their hands for this year.

Egypt.—The steam tramway between Alexandria and Ramleh is to be converted to electric traction.

Furness Railway.—At the half-yearly meeting of this railway company, Sir John Hibbert said that with respect to the proposal for the electrification of the Lakeside branch, the directors had come to the conclusion that, owing to the heavy expenditure, it would not pay to adopt it. They had the River Leven; but it would necessitate raising the weir at Newby Bridge 18 in., which would cost more than if power were obtained by steam. The directors had considered how far they could utilise a motor-car service on some of the branches. The idea was to have a combined engine and car to carry about 50 passengers.

Glossop.—The electric tramways system of the Urban Electric Supply Co. was formally inaugurated on Thursday last week. The system connects the town of Hadfield with Glossop by way of Dinting, so that an almost complete circle is described. The laying of the track and the erection of the overhead equipment has been carried out simultaneously with the building of the generating station which is situated between Glossop and Dinting, where electric lighting plant will also be installed. At present the Council has not sanctioned the lighting of the streets by electricity, but the Urban Electric Supply Co. regard their attitude on this question as distinctly favourable. The length of the Glossop system is about 3½ miles, constructed on the single track and loop plan. There is also a branch line running away from the circular main line to Whitfield, which is about three-quarters of a mile in length. A through connection with Manchester, by way of Hyde and Godby, is considered practicable. There is a proposal under consideration for constructing a tramway from the Glossop system to Hyde, from which place cars now run to the terminus of the Manchester tramway system at Denton. Mr. Page, a director of company, presided at the function, and Mr. Wigham conducted the

visitors through the different departments. The generating plant was started by Alderman Rowbottom and the Hon. Mrs. Hill-Wood. There are seven double-decker cars. The number of electric light consumers already secured in the town is 50.

The Great Western Railway and Motor-Cars.—Addressing the shareholders of this railway company at the half-yearly meeting, Earl Cawdor said that the arrangements for the electrification of the railway between Hammersmith and Bishops Road were proceeding. They proposed erecting a power station at Park Royal, which would also supply energy for the electric light. They were proposing to remove the present electric lighting works at Paddington, and to instal them on the new site at Park Royal, where they would have plant not only for working the railway, but also for lighting. A good deal was heard nowadays about motor-cars and electric trams. They had suffered a little already, and would doubtless in the future suffer more in some districts from that form of competition, and to meet it they were trying two experiments. One was they were putting on a motor-car service in country districts. Each car, which would carry 52 passengers, had its own engine, and would run on the ordinary railway lines. He hoped the first of these cars would be at work between Stonehouse and Chalford by October. They had made arrangements to stop the cars not only at regular stations, but also, with the sanction of the Board of Trade, at level crossings on the roads coming up to the lines. By that means they hoped to give a quick service for local people on cars running on their own lines at uniform fares like a tramway company. He thought the experiment was one from which much might be hoped for, and which they thought might turn out exceedingly useful, especially on branch lines. The motor-car would be worked by steam, but there were others which might be worked by petrol. In addition to that they had many places where independent persons ran motor-car services along the roads, to convey passengers to the railway. The board had carefully considered the question, and they saw no reason why they should not be able to feed the line themselves by motor-cars, and they had given instructions for five cars to be ordered, each of which would carry 22 passengers. They hoped by that means to be able to convey persons from a distance, to the railway. He had, no doubt, that these cars would be a great convenience to the public, and in addition their officials would be able to find out what amount of traffic there was in the district, which would be useful to them in deciding upon applications which were made for them to construct light railways. The first of these cars would be running immediately from Helston to the Lizard, and others would follow.

The Great Northern Railway and Electric Traction.—Addressing the shareholders of the Great Northern Railway Co. recently at the half-yearly meeting, Lord Allerton referred to the fact of the approaching completion of the two tube railways to Finsbury Park—the Great Northern and City, and the Great Northern, Piccadilly and Brompton—the promoters of which, he said, were sanguine that it would bring a largely increased traffic to the Great Northern line. Under those circumstances the problem that they, as a board, had to solve was a somewhat difficult one, and the board had had under consideration the question of electric traction for their suburban lines. The problem for solution was how to increase their maximum power of conveying passengers over a single line in a given time. If the anticipations of the promoters of the tube lines were correct, the board would not be justified in tinkering with the question, or in framing their plans on lines which did not contemplate the doubling, or even the trebling, at certain hours of the day, of their passenger traffic. At present they ran as many trains as they dared, and their officers had been considering in what way the position could be improved. During the investigation it had been shown that some facilities for increasing the carrying power were more or less common to either steam or electricity—he referred to providing longer trains and the widening of the carriages. Therefore the decision was between steam and electricity, and it would all depend whether a steam locomotive could be designed and constructed which would give much greater acceleration with more tractive power without unduly increasing and concentrating the weight. At present, as regarded acceleration, electric traction appeared to have a decided advantage. He had no doubt that the builders of steam locomotives in this country realised how important this matter was to the future of their industry, and they would be very curious to see whether any of them could find a practical solution of the problem. If they did they would certainly have a chance of getting good orders. At present, therefore, the board did not feel in a position to make any pronouncement on the merits as between steam and electric traction, but in the meantime they were pushing on with the improvements, which were common to either or both systems.

Huddersfield.—The Tramways Committee have instructed the manager (Mr. H. N. Thomas) to make arrangements for carrying a limited number of cycles on the cars at owners' risk.

Liverpool.—An improved cover for tramcars has been designed by Mr. E. R. Bellamy, general manager of the Liverpool Corporation tramways. The cover consists of a light framework similar to that used for the upper-deck covers for tramcars which have been in use in Liverpool for the last nine months; but instead of blinds being used to close in and protect the sides of the upper deck, windows will be fitted which can be raised or lowered in the manner of railway carriage windows. The roof is composed of sliding partitions, which will draw out and form a weather-tight top, or close up and leave two-thirds of the roof-space open to the sky. The new covers will cost about £35 each, as compared with £60, the cost of the present covers. The increased earnings of the cars which have had the covered tops during the last nine months have averaged 1½d. per car-mile, or £180 per car per annum. The outlay on the old covers was therefore a very profitable one. The Tramways Committee have ordered 20 covers of the new design to be constructed at their Lambeth Road works as an experimental installation.

Liverpool and Southport Electric Railway.—It is stated that the work of the electrification of the Liverpool and Southport section of the Lancashire and Yorkshire Railway is being rapidly pushed on, and good progress has been made both on the line itself, at the Formby generating station, and at the Birkdale transforming station. It is stated that over a month must elapse before the work on the line itself can be completed.

Manchester.—At an inquest into the death of a three-year-old child who was killed at Failsworth on August 16th, by an electric car, the evidence given by the driver showed that the "cow-catcher" would not act. The emergency brake was applied; the distance from where the child was struck, to the place where the car stopped, was 36 yards.

Paris.—The Prefect of Police has advised the Paris Metropolitan Railway Co. of the new measures of reform and the precautions for safety of passengers which will be required to be introduced on its system. The modifications, says Dalziel's Paris correspondent, are divided into three series. First, those to be put into immediate execution; second, those to be introduced before September 5th; and third, those to be begun by November 1st. The first series includes the appointment of inspectors, one for every five stations; every short circuit is to be reported to an inspector, who shall thereupon determine the measures to be adopted. Independent lights are to be placed in every station to indicate the way out, and all needless barriers are to be removed. In the second series the company is required to isolate completely the motor-car from the other cars composing the train. All offices and installation boxes at the stations are to be constructed of incombustible material, an independent system of lighting is to be installed, special fire alarms are to be placed in telephonic communication with the nearest fire station. The third series contains a recommendation to study other systems of traction possessing fewer dangers of fire or panic than the one at present in use. The third rail carrying the electric current is to be properly guarded, so as to protect passengers, who may be obliged to walk along the track, from danger of electrocution. All the stations are to have at least two exits, and air shafts are to be constructed between the stations.

Russia.—As the schemes submitted by the American or Russo-American promoters for the conversion to electric traction of the existing tramways and the construction of new lines in St. Petersburg and Moscow have been definitely rejected by the respective municipal authorities, the latter are now on the point of taking practical steps towards the carrying out of the work on their own account, by inviting tenders from competent companies or firms for the contracts, which are estimated at about £2,000,000. In order that the contracts may not be placed with foreign firms, the representatives of 14 Russian iron works, machinery builders and electro-mechanical works have presented petitions to the Minister of Finance and the Minister for Home Affairs, praying that the obligation may be placed upon the St. Petersburg and Moscow municipal authorities to order everything required for the proposed electric tramways from Russian works. The prospect of the contracts being thrown open to international competition has also engaged the attention of the petitioners, who represent a share capital of £27,000,000 and employ 77,000 workmen, and they suggest that even to avoid a portion of the work being entrusted to external competitors, the Ministers should order the municipal authorities to restrict the competition exclusively to native works. As differences between the Government and the municipal authorities arose some time ago in regard to the electric tramways and electric railways proposed by American or Russo-American promoters, it will be interesting to learn how the former will act in view of the request of the petitioners.—*Financial Times.*

Stirling.—The T.C. has under consideration the construction of a narrow gauge electric tramway from Bridge of Allan to Bannockburn, as an alternative to electrifying the existing line in the event of purchase.

Wallasey.—On Tuesday last week there was a three hours' stoppage of the electric tramway system, the cause being stated as the fusion of an underground main near the depôt.

Wirral Railways.—At the half-yearly meeting of the Wirral Railways Co., Mr. T. H. Jackson, who presided, said he regretted that the receipts showed a considerable falling off, especially in first-class passengers. They had carried 32,549 fewer first and 27,888 fewer third-class passengers. There was against that an increase in the season tickets and in the coal traffic. The decrease in the passenger traffic he attributed to the competition of the electric trams, through which they had lost 25 per cent. of the New Brighton traffic. So far, he was sorry to say, the electrified Mersey Railway had not brought them any great advantage. Much had been said lately about self-propelled motors for railways. The directors had looked into the question, and they believed that in the end that kind of locomotion would be found to be extremely suitable for their railway, but so far their engineers had not been able to recommend any particular car, and they must wait for a more perfect one. They were still inquiring into the matter.

(*Continued on page* 347.)

THE BROTHERHOOD ENGINE WORKS.

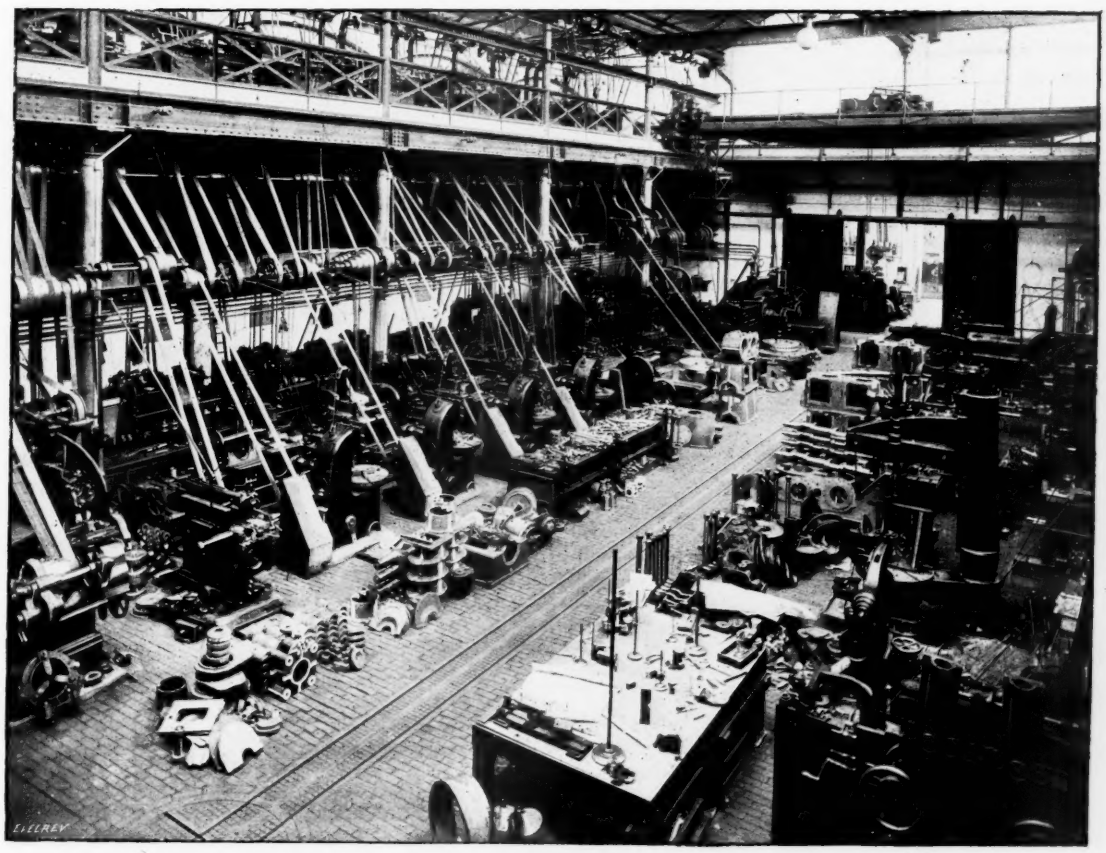
The name of Brotherhood has been inseparably connected with the electrical engineering industry from its earliest days. Long before the dynamo left the category of "philosophical instruments" and the companionship of "postage-stamp edging and sealing-wax," to quote Mr. Swinburne's classic phrase, and became a practical and workmanlike machine, Mr. Peter Brotherhood designed and brought to a high stage of perfection the ingenious three-cylinder engine with which his name is for ever associated.

Thus it was that Mr. Brotherhood was able to lead the way in the direct coupling of dynamos to steam engines, for his was the only high-speed engine in existence that was suitable for this purpose. Some of the very first Gramme dynamos introduced into this country were coupled to his engines in 1878-9, and examples are on record of almost all the earliest types—Siemens, Bürgin, Edison, Victoria, &c.—driven direct by Brotherhood engines. Many of our readers are probably unfamiliar with these pioneer sets; we therefore reproduce illustrations of some of them as affording an interesting comparison with present-day practice, and as evidence of the advanced ideas of Mr. Brotherhood.

The first Brush dynamos imported, in 1880, were coupled to these three-cylinder engines, and an enormous number of the latter were made for electric lighting purposes, especially in connection with installations on naval vessels. The British Admiralty adopted electric searchlight projectors many years before the electric lighting of ships became general. These searchlights were operated by dynamos of various makes, but almost invariably coupled to Brotherhood engines. Amongst other applications of the three-cylinder engine were the driving of the steering gear, and of air compressors; the latter were made almost exactly like the steam engines, thus anticipating by many years the type which has lately been re-introduced, with several cylinders arranged radially round one crank-pin, for driving by electro-motors.

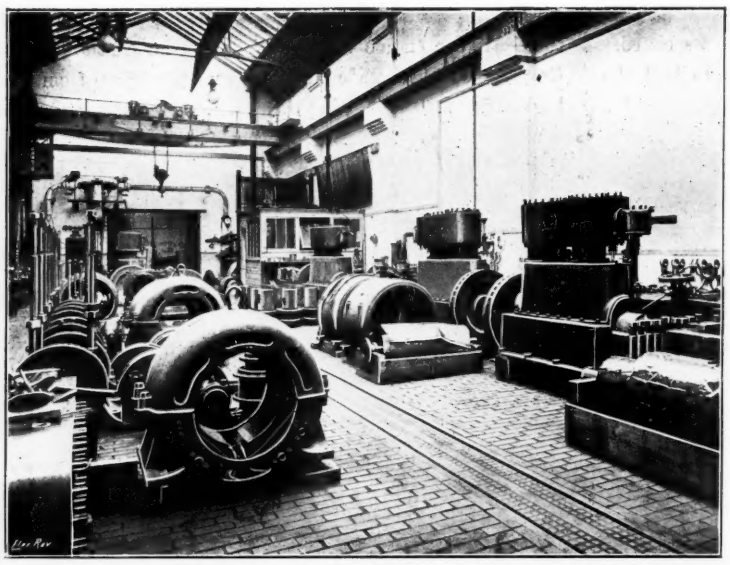
Although the firm has of late years turned its attention more particularly to the vertical type of engine, it must not be supposed either that this is a new departure, or that the three-cylinder engine is obsolete. On the contrary, Mr. Brotherhood's firm made numerous vertical engines from the beginning, embodying in their design various ingenious devices, such as automatic (but not forced) lubrication, the single valve for compound engines, valve-rods carried through the pistons and worked by eccentrics on the crankshaft, and the complete enclosure of the crank chamber; moreover, the three-cylinder engine is made in large numbers to this day, for operation by steam, air and water pressure. These engines are applied to many purposes, including the driving of Whitehead torpedoes by compressed air. We understand that all these torpedoes made for the British Navy are fitted with Brotherhood three-cylinder engines; and it is a fact, as surprising as it is interesting, that while these weigh only 50 lbs. each, they give out no less than 50 H.P. They are made entirely of bronze of special quality, and the three cylinders are cast in one piece; some of the castings are visible in our view of the "East Gallery."

The firm was originally styled Kittoe & Brotherhood; later it became Brotherhood & Hardingham, in 1873. The works



Main Machine Shop, Looking North.

were situated in Compton Street, Clerkenwell, but in 1882, Mr. Brotherhood, who had become the sole partner, decided to build new works on up-to-date lines, and selected a site on the south bank of the Thames, in Belvedere Road. These works were at the time regarded as admirably laid out for the special purpose for which they were required; and even at the present day, when works organisation has been elevated to the position of an art, they are well able to hold their own amongst establishments of similar character and scope. The buildings consisted of a main machine shop with two galleries, separated from the roadway by the offices; smiths' shop and foundry; boiler house, &c. To these were added, in 1884, a pattern shop and torpedo engine shop, and in 1897 considerable extensions were carried out, consisting of two bays, which are laid out as erecting shops, foundries, coppersmiths' shop, power house and test rooms. Views of several of these departments are given herewith. All the shops are well lighted from the roof.



A Corner of the Erecting Shop.

Electrical appliances have been largely used in the works, which were lighted throughout with electricity when first built. The generating plant then consisted of Siemens dynamos, coupled direct to Brotherhood three-cylinder engines. When the extensions were made in 1897, electric driving was adopted for the whole of the machinery, and new generating plant was put down, which was constructed in the works. Independent motors were applied to groups of machines, to various isolated machines in the pattern-shops and foundry, and to the smiths' and coppersmiths' fans. The shafting in the main machine shop and in the galleries above is driven by two large motors. The shops are provided with three-motor electric cranes built by Messrs. Adamson and Co., of Hyde.

The machine tools installed in the works are of modern high-class types, and are kept up to date by frequent additions. They comprise the usual outfit of lathes, planers, boring mills, milling machines, &c., together with a number of machines designed for executing rapidly the special class of work produced. Examples of tools by most of the leading British and American makers are included.

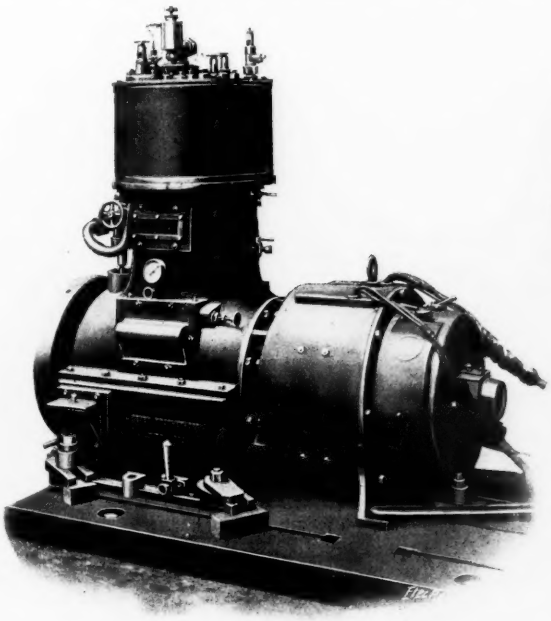
All the iron, brass, and bronze castings required are made in the works, excepting the heaviest pieces in cast-iron. Special attention has been given for many years to the production of bronze castings of maximum strength and endurance. That the results have been satisfactory may be seen from the instance given above in connection with the three-cylinder engines for torpedoes.

The testing department is situated at the end of the erecting shop, and is well equipped with measuring instruments, resistances and switchgear for testing electrical plant, as well as apparatus for testing air compressors, &c. Test plates and appliances are provided for rapidly fixing and coupling up steam engines and testing them over a wide range of loads, either condensing, non-condensing, or exhausting against steam pressure, as when the exhaust of the auxiliaries is taken into the low-pressure receiver of the main engines on board ship. Special provision is made for carrying out steam consumption tests, including tanks and weighing machines. There is a surface condenser specially constructed for consumption tests, and equipped with independent air pumps, valves and connections. Water for condensing purposes is derived from a deep well by means of a centrifugal pump, driven by an electromotor. Steam is provided for operating the works and for testing by Babcock & Wilcox boilers, built for pressures up to 300 lbs. per sq. in., and fitted with superheaters capable of supplying steam with 120° of superheat at the testing beds. When it is desired to subject a steam dynamo to several days' test, the dynamo is coupled up to the works mains, any surplus current being absorbed by resistances.

View in East Gallery of Main Machine Shop.

The type of Brotherhood engine of chief interest to electrical engineers is doubtless that which we illustrate, coupled to a Crompton dynamo. This engine is of the high speed enclosed type, designed to give a high degree of economy, with close governing and great durability; it works silently and with the minimum of vibration, being well balanced and lubricated with oil under pressure. All parts of

engines of the same size are made interchangeable. Piston valves are used throughout, those on the high-pressure cylinder being solid, ground to fit the bore, while the low-pressure valves are fitted with spring rings. The



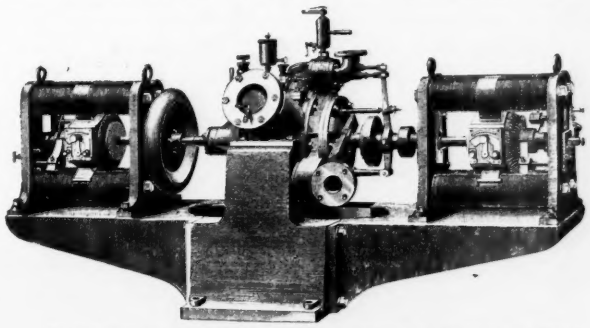
Brotherhood's Patent Air Compressor Coupled Direct to a Six-Pole Motor.

piston rods and guide slippers are finished by grinding, to ensure perfect truth. The bearing surfaces are of large size, and most of them are lined with white metal. The valveless pump, which forces oil to all the working parts, is provided with duplicate strainers, so arranged that either strainer may be removed and cleaned while the engine is running, without admitting dirt into the pipes or interfering with the action of the other strainer. The governor is usually of the throttling type, mounted on the crankshaft, and is so arranged that while close regulation is secured at all speeds, a wide variation of speed can be obtained whilst the engine is running. It is found in practice that the variation of speed can easily be kept below 1·6 per cent. between no load and full load, or *vice versâ*, and the run-up when the load is suddenly thrown off is less than 4 per cent. This regulation is maintained over a range of 30 per cent. upwards from the lowest speed. The engine illustrated is of the two-crank compound type; three-crank compound and triple-expansion engines are also made, as well as single-crank simple or tandem compound engines. Every engine made in the works is tested for steam consumption per hour per brake or electrical horse-power under working conditions.

South End of Iron Foundry.

The works are provided with a tool room, in which gauges and fine tools of special type are made. The interchangeable system of working was adopted by Mr. Brotherhood prior to the establishment of the present works—a very early period in the history of this system; it has been in use ever since. The limit gauge system is at present largely used in the works; the gauges are made on the spot, and are adjusted by comparison with standard measuring machines.

The manufacture of petrol engines for motor-cars, driving small dynamos, &c., has recently been commenced—largely



Brotherhood 3-cylinder Engine, Coupled Direct to Two Gramme Machines (Date 1879).

in consequence of the exceptional facilities which exist for turning out accurate interchangeable work in Mr. Brotherhood's establishment—and these engines have proved very successful. At present the entire output is taken up for a newly-designed car bearing the firm's name; but we hope shortly to illustrate one of these engines coupled to a dynamo.

The premium system of payment was introduced some time ago, and has given results satisfactory to both the firm and to the employés. The system is very simple: a standard time is fixed for the execution of a given operation, and if it is accomplished in less than the standard time, half the time saved is credited to the workman at full time rates. Should the time be exceeded, the workman is paid at the full day rate; so that, while he can never lose by the system, he has an excellent chance of increasing his earnings.

Since the death of Mr. Peter Brotherhood in 1902, the business has been carried on by his son, Mr. Stanley Brotherhood, assisted by Mr. C. W. Bryant as engineering manager. We are indebted to Mr. Brotherhood for freely affording us facilities to obtain photographs of the works, and to Mr. Bryant for his courteous assistance in the preparation of the foregoing particulars.

A QUESTION IN DEPRECIATION.

By an Engineer.

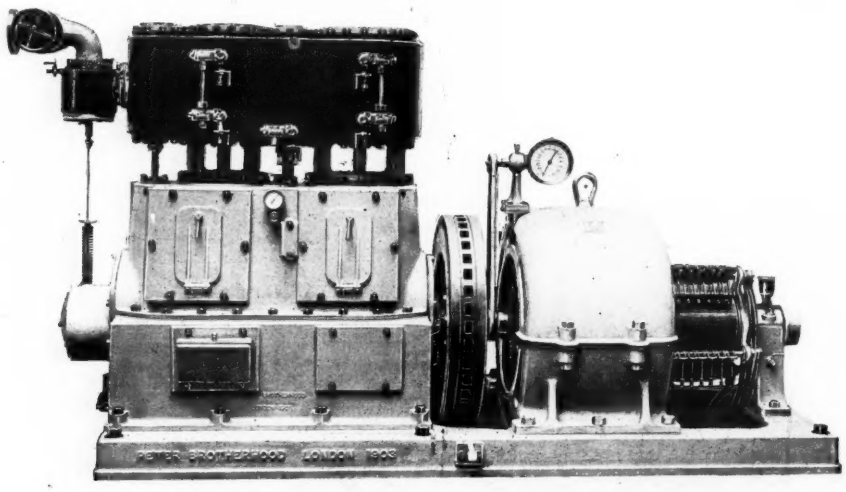
It will not be denied that in every new undertaking the setting aside of an annual sum to cover depreciation of plant is fit and proper when making an estimate of the returns to be expected.

As an example, the case of independent lighting plant may well be cited. The cost at which energy can be purchased is known. If it is to be made by a private plant, the depreciation of this plant must be allowed for if a fair estimate is to be arrived at. But depreciation should not be accepted as of universal application, for there are numerous occasions wherein it cannot be admitted if a sound commercial estimate is to be made. Let the case be considered of an independent plant that has already been at work several years, and the future economy of which is to be decided upon. Inquiry need not be made into the early history of the plant or the reasons which led up to it installation. It may even be granted that the installation

was initially an error, and that the economy secured over purchased energy will vanish if the depreciation be deducted. These matters are past and gone.

The plant is there for better or worse. It has been paid for, and has or has not proved a commercial success. This matters nothing to the inquiry of to-day, which is whether further working of the plant will pay better than purchasing energy. Let it be supposed that originally the plant cost

The fact that even then the undertaking has proved a loss does but prove that there was an initial error in putting it down, but it does not prove that when that error has been found out there must or can be a recurrence to sound principles of finance, because the error once made is irremediable, and it remains only to make the best of it. If plant would sell at the book value a mistake could always be cut short by sale of plant, but plant which may be worth book value



Brotherhood Vertical Enclosed Engine Driving Crompton Dynamo.

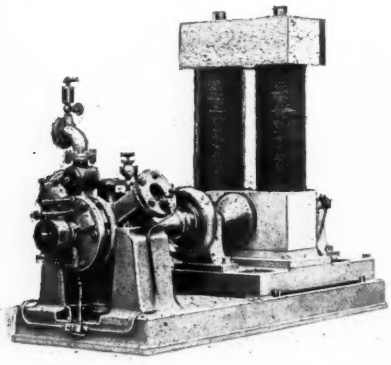
£6,000, and that it costs to work it £1,500 a year, and that energy can be bought for £1,700. If the present supposed depreciated value of the plant is £3,500, it should normally be depreciated £350 during the year to come, so that on this basis, assuming depreciation, the working cost will really be £1,850, or £150 more than purchased energy. Apparently the proper course would be to stop the plant and buy electricity. But the plant would only sell for scrap-iron price. It will sell for as much if run for five or for 10 more years. It is there and cannot be unpurchased. Obviously then if a correct estimate is to be arrived at the plant must be taken as a free gift from a past error, and the future working costs must be calculated without depreciation. Already, let it be supposed, a loss of £5,000 has been made on its working. This cannot be recouped during the remainder of the life of the plant. But it may be possible to run the plant for five more years, and to do so for £200 per annum less than bought electricity would cost. Here, then, is the chance of wiping out £1,000 of the loss already made, whereas if depreciation had been pedantically insisted upon the full loss would have remained, and the plant sold for no more than it will fetch after a few years' more work. When at last the old plant can no longer be run for the price of purchased energy, it should be stopped and sold.

as a going item becomes scrap very quickly if an attempt is made to sell it. Under such and similar circumstances, it becomes justifiable, in fact, commercially correct, to ignore depreciation in a plant which is already at scrap price though not at scrap value for the work it may still perform.

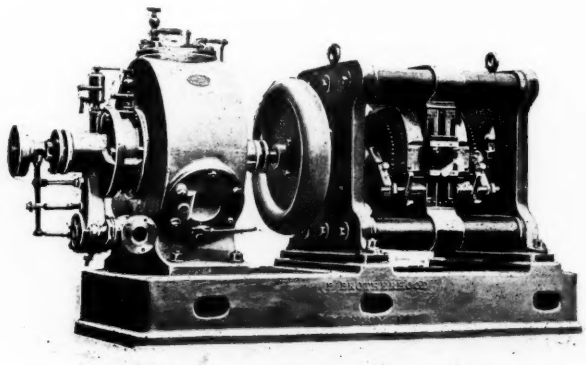
Another somewhat parallel argument will attach to the evaluation of the work done by a plant and the apportionment of costs. It may occur that a private electric light plant is run in connection with other plant which cannot be dispensed with. Firing of boilers costs, say, £80 per annum, and is equally divided between the two sets of plant. Tests show that coal costs £40 net for each plant, and a further £15 for stand-by losses. When both sets of plant are at work, each is costing £47 10s. in fuel, and £40 in wages—an equal division, or a total of £87 10s. each. If one plant is to be stopped, however, it will not produce an economy of this last amount.

Probably the only economy will be the £40 on net coal, for all the stand-by loss of £15 is now thrown upon the remaining plant, as well also as all the £80 in wages.

Here the cost of the second plant in wages and coal is only really £40 per annum, for this is all that would be saved by its stoppage. It may be perfectly right to divide running costs in a strict proportion over all the plant at work, but when it comes to stopping one-half, the other half



Brotherhood 3-cylinder Engine Direct Coupled to Edison Dynamo.



Brotherhood 3-cylinder Engine Direct Coupled to Victoria Dynamo.

must carry an extra load of standing charges, and the economy of stopping the one set cannot be more than the bare difference it makes. It can never be so much as the proper division as between running plant.

The foregoing are but simple and elementary instances where the economy of a given course of action must be estimated on quite different lines according to the conditions. One cannot get away from an accomplished fact, and must not, therefore, be tied down by axioms that only properly apply before calculations on paper have been materialised in the form of plant, and the money sunk past recovery except by work.

ELECTRIC TRACTION NOTES.

(*Continued from page* 342.)

Spain.—An electric railway has just been completed and opened for traffic between San Sebastian, Astigarraga, Loyola and Hernani. The new line, which is about 10 kilometres long, has been built and equipped by the Sociedad Thomson-Houston Iberica, of Bilbao.

Taff Vale Railway and Electric Traction.—Addressing the shareholders of this railway recently, the Chairman, Mr. R. L. G. Vassall, said:—They had obtained powers for the electrification of their railway, and had intended introducing carriages with self-contained electric power. They obtained tenders, but none of them were accepted, as from an inspection of the steam motor carriages now being used by the London and South-Western Railway, it was concluded that it was better to adopt that method of coach than a coach moved by electric power. They were now building, as an experiment, a self-contained steam motor carriage, and they hoped it would prove useful for carrying passengers short distances.

TELEGRAPH AND TELEPHONE NOTES.

American Pacific Cable.—This cable (of the Commercial Co.) was opened for commercial cable business to and from the Philippine and Ladrone Islands, China, Japan and Korea, on July 25th.

Brighton Telephones.—The Brighton Telephones Committee recently approved the engineer's revised estimate of the cost of telephoning Hove underground, and resolved that application be made to the Local Government Board for sanction to borrow a sum of £4,691 instead of the sum of £3,000 previously applied for, to defray the cost of laying ducts and constructing other works in Hove for extending the telephone undertaking to that borough, such loan to be repaid within 25 years.

Telegraphic Interruptions and Repairs :—

Cables.	Interrupted.	Repaired.
Latakia-Cyprus	June 20, 1899	
Trinidad-Demerara No. 1	Aug. 27, 1901	
Dominica-Martinique	May 8, 1902	
St. Lucia-Martinique	May 8, 1902	
Guadeloupe-Martinique	May 9, 1902	
Martinique-Puerto Plata	July 10, 1902	
Cayenne-Pinheiro	Aug. 18, 1902	
St. Lucia-St. Vincent	Sept. 19, 1902	
Reissa-Issa	Oct. 22, 1902	
Reissa-Yemani	Oct. 22, 1902	
Paramaribo-Cayenne	Feb. 27, 1903	
New York-Haiti	April 13, 1903	
Fao-Bushire	July 28, 1903	
Bolama-Bissao	Aug. 4, 1903	
Antigua-Guadeloupe	Aug. 9, 1903	
Mozambique-Madagascar	Aug. 20, 1903	
Landlines.		
To Puerto Barrios	July 28, 1903	
Rome-Pera	Aug. 8, 1903	

Hull Telephones.—At a meeting of the Corporation Telephones Committee on 18th inst., the following report was presented to the sub-committee:—

"We had an interview with the representatives of the National Telephone Co. at Hull on 5th inst., when, after considerable discussion, the following basis of arrangement was agreed to by both parties, and we recommend its adoption by the Committee and the Council:—

"That in consideration of the National Telephone Co. withdrawing their appeal and agreeing to mutual free intercommunication between their subscribers in the Hull area and those who may join the Corporation system, and also mutual intercommunication between the latter and the subscribers in other towns through the trunk wires of the Postmaster-General, without any terminal or other charge being made by either the company or the Corporation, the Corporation shall continue present and future underground wayleaves to the company until the expiration of the company's licence in 1911, on the terms of the agreement of March 18th, 1899, except that the demands therefor under such agreement shall be reduced by one-half as from March 18th next, the cost of the necessary junction lines to be borne equally by the company and the Corporation.

"We are of opinion, as a result of our discussion with the representatives of the company, that in the event of the Corporation not entering into competition at present, an alternative arrangement could be effected on the following basis:—

"1. The company to forthwith introduce (in addition to the existing party lines and other services) a measured service tariff on the following scale:—£5 to cover 600 calls per annum; £6 1,000 calls; £7 1,600 calls; £8 2,100 calls; and £9 2,600 calls. All inward calls to be free, and excess local calls to be charged for at the rate of 1d. per call.

"2. The unlimited rates to remain as at present; and

"3. The company to pay for the underground wayleaves the full charges mentioned in the agreement of March 18th, 1899."

The recommendation of the Committee with reference to the arrangement set forth in the first part of the report was adopted.

Wireless Telegraph Congress.—We learn from a correspondent in Brussels that the members of the congress were in agreement as to the main lines of policy and the necessity for a conference; the English delegates, however, made reservations, as they held themselves bound by their engagements with the Marconi Co. The monopoly granted to Marconi by the Italian Government is one of a highly detrimental nature, for if other inventors made great advances in wireless telegraphy, the Government will be unable to take advantage of them. The Marquis di Solari, it is said, distinguished himself at the congress by his loquacity; but his long speeches, although not without interest, left the impression that it was not the voice of the scientist, but of the collaborator of Marconi, who in defending the latter defended his own interests. One of his principal arguments was that Marconi being the promoter of wireless telegraphy, and his company having carried out experiments at great cost, they were deserving of special consideration; but this view met with little favour. The Marquis left Berlin before the close of the congress, for what reason is not known. The members of the congress visited the installations of the "Telefunken" Co., the amalgamated Braun-Siemens & Halske and Slaby-Arco Syndicate. M. L. Comte Arco entertained them with trials of multiple wireless telegraphy; M. Seibt showed an apparatus of his own invention for demonstrating the fundamental principles of the science; M. Schmidt explained the use of some new instruments for measuring electric waves, by means of which stations worked on different systems could be tuned in agreement; M. Schloemilch showed his new receiver utilising the influence of the electric oscillations upon a polarisation cell. Sparks two metres long were produced for the edification of the visitors, who afterwards visited the huge installation at Oberschönweide intended for communicating with a Swedish Naval station at Karlskrona, 450 km. distant (including 150 km. overland).

Arrangements were made for a Congress to be held again at Berlin next year, to go into the details of the proposed regulations, which have as yet only been touched upon.

Wireless Telegraphy.—The re-establishment of the trans-Atlantic service is a matter of the most profound indefiniteness. The prospect of resumption is becoming more remote than ever. We read that a morning paper has been officially informed by the Marconi Co. to the following effect:—

"Our machinery at Poldhu was, it is true, injured by an accident on April 1st last, but nothing in the nature of an explosion took place. Communication was re-established, the interruption of the service being due to a breakdown in certain machinery commonly used for many other purposes than wireless telegraphy. While the repairs were in hand Mr. Marconi had made what appeared to be a very important improvement. This is being tested with a view to its use in connection with the trans-Atlantic service, and *until we know whether it will be embodied in the trans-Atlantic stations or not, we shall probably not open them for any public service such as the 'Times' messages*, as if we decide to utilise this new improvement the service will again have to be interrupted if the alterations are to be made."

It is quite clear from this that "By Marconigram" need not be expected to appear at the heading of the *Times* American correspondence for some time to come.

Mr. Herbert Russell, who was on board H.M.S. *Hood* during the manœuvres, writing in the *Daily Express* of Tuesday last, says that wireless telegraphy during the manœuvres did nothing further than demonstrate its absolute inutility in its existing form for sea war purposes, owing to its liability to be intercepted and distorted. It even ceased to be a means of baffling the enemy, because neither side paid the least attention to the disjointed messages.

Mr. Marconi left Liverpool on Saturday for New York in the Cunard liner *Lucania*. The principal object of his visit is to make experiments with a view to further perfecting his system of wireless telegraphy, and these will be made on board the *Lucania*, which has been specially fitted for this purpose with more apparatus. A few days ago an independent apparatus was fixed to the aft mast which connects with the cabin Mr. Marconi occupies on the voyage, and by means of indicators he will be enabled to judge as to the intensity of the messages required at certain distances. These experiments are to ascertain what is the actual power required to send a message a certain distance on a moving station such as the *Lucania* or other of the Cunard boats.—*Times*.

CONTRACTS OPEN AND CLOSED.

OPEN.

Belgium.—Tenders have just been invited for the concession for the supply of electrical energy for lighting and power purposes in the little town of Ciney (Namur province).

Brisbane.—September 30th. The deputy Postmaster-General is in the market for certain postal and telegraphic material.

France.—The French Ministry of the Colonies in Paris has placed a contract with the Société Metallurgique de Gorcy (Meurthe et Moselle) for 60 tons of galvanised iron wire 3 mm. diameter, required for the telegraph service in Indo-China.

France.—September 3rd. The French Post and Telegraph Authorities are inviting tenders until September 3rd for the supply of 104 tons of telegraph wire. Tenders are to be sent to Le Sous-Secretaire d'Etat des Postes et des Telegraphes, Rue de Grenelle, 103, Paris, whence particulars may be obtained.

France.—Tenders are at present being invited by the Municipal Authorities of Besancon (Doubs) for the concession for the establishment and working of a central power station to supply electrical energy to Besancon and Mouthier, utilising the water power of the falls on the River La Loue, the flow of which is estimated at about 2,000 litres per second.

Holland.—October 1st. Tenders are being invited by the municipal authorities of Utrecht for the construction and equipment of a central electricity station for lighting and power purposes, and for the working of a tramway.

Hungary.—August 31st. Tenders are being invited until the 31st inst. by the municipal authorities of Besztercsebanya (Neusohl) for the establishment in the town of a central electricity generating station of a capacity of 500 H.P.

Greece.—September 10th. The Municipal Authorities of La Canée are inviting tenders until September 10th for the electric lighting of the town.

Ipswich.—August 28th. Light and power installation in generating station, &c. See "Official Notices" August 21st.

Johannesburg.—October 19th. Gas producer plant; gas engines and dynamos. Alternative:—Water-tube boilers, steam engines or turbines, electric generators, and other plant. For the municipal tramways and electrical supply scheme. See "Official Notices" to-day.

Launceston (Tasmania).—September 28th. 500 or more electric meters. See "Official Notices" June 12th.

London.—October 6th. Four 5,000-H.P. vertical-horizontal steam engines, each suitable for driving a three-phase generator, for the Greenwich power station. See "Official Notices" July 24th.

New South Wales.—September 12th. Tenders are being invited by the Railway Commissioners for New South Wales for an additional generating set of 1,500 KW. for their tramway power station.

Pietermaritzburg.—September 7th. Poles and overhead equipment for the Corporation tramways. See "Official Notices" August 21st.

Portugal.—October 21st. Tenders are being invited until October 21st by the Portuguese Ministry of the Colonies in Lisbon for the concession for the electric lighting of the town of Macao in the Portuguese Colonies.

Radcliffe.—September 5th. Tramway and lighting feeders, cables, conduits and accessories. See "Official Notices" August 21st.

Southend.—September 14th. Steam dynamo, boiler and condenser for the electricity works. See "Official Notices" to-day.

Spain.—September 5th. The Spanish Post and Telegraph Authorities are inviting tenders until September 5th for the establishment and working of a telephonic system at San Lorenzo del Escorial. Particulars may be obtained from, and tenders are to be sent to, La Direccion General de Correos y Telegrafos, Carretas, 10, Madrid.

Stoke-upon-Trent.—September 11th. Pipe-work, non-conducting covering, and water-softening plant for the electricity scheme. See "Official Notices" August 21st.

Whitechapel.—September 12th. Electric lighting of a portion of the Infirmary. See "Official Notices" to-day.

CLOSED.

Bootle.—The Corporation has accepted the combined tender of Messrs. Ferranti and Bruce Peebles & Co., Ltd., for two 600-KW. Ferranti-Peebles traction generating sets. The engines are to be of Ferranti's cross-compound type, and the generators of Peebles's standard multipolar traction type.

Metropolitan and District Railways.—We are informed that the Underground Electric Railways Company, of London, Limited, has awarded the contract for the entire control equipments for its new electric trains on the Metropolitan District Railway to the British Thomson-Houston Co., Limited, of Rugby. The system to be employed is the Sprague-Thomson-Houston multiple unit system, with which an experimental train has been equipped on the company's newly-opened line from Ealing to Harrow, and on which, for over four months past, continuous experiments and competitive tests under special and normal conditions of traffic have been going on, to ascertain which of the two systems of control competing will best meet the various requirements of this railway, having a due regard to the safety of passengers, reliability of control, economy of power, low cost of maintenance, comfort to passengers, and simplicity. We learn that it was after thoroughly weighing all these matters that the contract was, as mentioned, awarded to the British Thomson-Houston Co., Ltd. A somewhat similar series of tests were made before the decision was arrived at as to what system of control should be adopted on the New York underground railways, and the same system of multiple unit train control was decided upon. This system is being used, or contracted for, by over 32 railways throughout the entire world, over 2,000 equipments being at present in use.

FORTHCOMING EVENTS.

Wednesday, September 9th.—Meeting of the British Association for the Advancement of Science opens at Southport.

ADDENDUM TO ELECTRICITY WORKS LISTS.

SHOREDITCH.—Whiston Street works opened 1902; 4 B. & W "marine," 2 Wallsend-Westinghouse steam dynamos, total capacity 1,600 KW. Max. load in both stations 1,880 KW. Total cap. expd. £289,744. Pb. ltg. 286 arc. Motors 300 = 1,500 B.H.P. Units sold 3,040,964. Price obtd. 3·034d.; works costs 2·07d.; total costs 3·041d.

NOTES.

The Late Lord Salisbury.—The career of the great statesman who has passed away at Hatfield since the appearance of our last issue, has been completely and admirably placed before the world in the newspapers, and the eulogiums of these have varied largely according to the shades of their political views. But in an organ devoted to electrical science and engineering, we are happily freed from the embarrassment of political tension; the more especially is this the case in the present instance, for we believe that all electrical engineers, whatever may have been their political leanings—had a peculiar regard for Lord Salisbury because of the personal interest which he had for many years taken in electrical and other departments of scientific discovery and research. This interest is exemplified in the fact that the official list of members of the Institution of Electrical Engineers contains the following entry among its members:—

> "1894.—Salisbury, the Marquis of, K.G., P.C., D.C.L., F.R.S., &c., Hatfield House, Herts."

As a president of the British Association for the Advancement of Science, he also demonstrated in a practical manner that his was no mere smattering of matters scientific, and science universally will feel the loss it has sustained in the death of this great and good man, *sans peur et sans reproche.*

The London 'Bus.—Alderman John Pound told the shareholders of the London General Omnibus Co. the other day that he could not say whether the London omnibus was going to remain a horse-drawn vehicle. Motor 'buses had been delivered to them, and while the authorities were deciding if they would license them, the company was testing them in various ways. With regard to motors, the two main points to consider were safety and economy of working. At the present time their position was such that they could profitably adopt motors, but they must first be satisfied that motors would carry the public safely, and would be worked at least as economically as their present vehicles.

Motor-Hansoms.—It is reported that the London Express Motor Service, Ltd., of 37, Walbrook, E.C., will in three months' time place 50 motor-driven hansom cabs on the London streets to ply for hire. This is said to be the outcome of exhaustive experiments extending over the past six months.

Switzerland.—The Union Vandoise der Commerce et de l'Industrie, of Lausanne, is offering a prize of 4,000 fr. (£160) for the best scheme for the application of electric power in the Canton of Vaud to the development of industry in general and to the introduction of domestic industries in particular.

The Quimby Pump.—A novel type of screw pump is the Quimby, which is being introduced by the Quimby Co., who have their London office in Temple Bar House. This pump consists of two rapidly revolving spindles each carrying a pair of oppositely-screwed helices which gear with the similar helices on the parallel spindle as clearly shown in fig. 1. One spindle is driven by the other, which in turn is driven by a motor, a belt, or any other means. The pump is noiseless in action, and the first made machines seven years old are still at work. It will pump water, oil, tar, molasses, paper pulp or cement slip, or indeed anything that will flow, and will work up to pressures of 120 lbs. per sq. in. It is specially suitable for motor-driving, because it has no points of greater or less resistance, and is always steady. When electrically-driven it can easily be set to start and stop automatically.

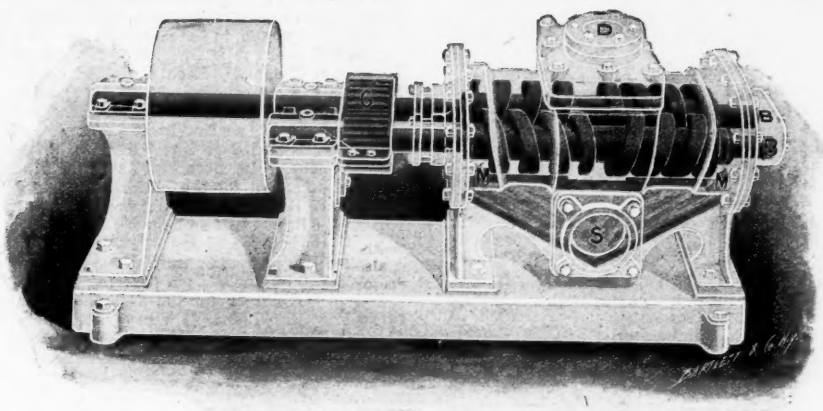


FIG. 1.—MOTOR-DRIVEN QUIMBY PUMP.

The method of working of this pump appears to be that the threaded parts of the spindle fit the pump case, while the opposite intergeared helix acts as a displacer and compels the liquid to flow towards the outlet. Being opposite in their screwing, the two helices serve to equilibrate the end thrust, reducing friction to a minimum and securing good overall efficiency, which varies from 60 per cent. for pressures of 125 lbs. up to 65 per cent. for half that pressure. There is of course a pair of wheels gearing the two spindles of the pump rigidly together, as shown at G in fig. 1. The external appearance of a motor-driven pump is shown in fig. 2. Very little foundation is required, though speeds are as high as 900 to 1,400 revolutions per minute, according to size.

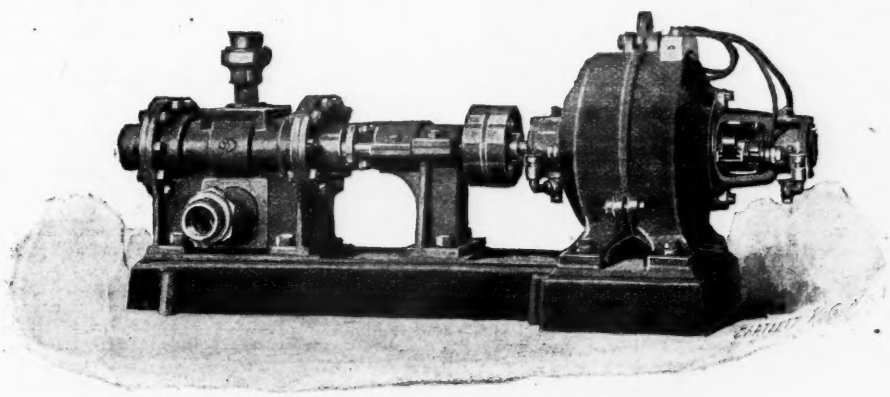


FIG. 2.—MOTOR-DRIVEN QUIMBY PUMP.

The Hammersmith and Brompton Railway Floods.—The ever-recurring stoppages of traffic on London's most important east and west artery, due to temporary and preventible flooding, surely call for some explanation on the part of those in command. The fact that London's travelling public appears to have become resigned to its long suffering will perhaps account for the apathy which the company's engineers have displayed in past years, toward what in any other place but London would be justly regarded as a disgraceful state of affairs. It is not sufficient, either for those who run the line or those who use it, that the company shift the responsibility on to the shoulders of the local drainage authorities; that the latter course will lead to complications and vexatious delays is inevitable, while the hapless passengers continue meanwhile to suffer the greatest inconvenience. One may well ask who is responsible for a state of affairs which can lead so frequently to the disorganisation of a railway system. The District Railway was not built yesterday, and the flooding, which has occurred about six times during the present year, cannot have been unknown in previous years. If the electrical engineering interest was a dominating one, we could have understood references on the part of the mechanical and civil engineering fraternities to lack of competency in things other than electrical; but the facts are the other way, and it will remain for those responsible for the electrification to provide the solution to a question which admits of no delay.

To suggest the best means of coping with the difficulty without a full knowledge of the circumstances, is, of course, impossible; but the pressing need leads us to suggest the feasibility of employing electrically-driven pumps, in connection with suitable drainage sumps, and special pipe lines delivering into the river above high tide level, or into some other reliable drainage system. The expenditure, even if considerable, is unavoidable, and cannot be compared with the losses entailed by successive dislocations of traffic. Electrical power has been at hand for years, in both West Brompton and Hammersmith, and the electrical departments are laid out with a view to supplying just such sudden demands as these. Taking into account the gravity of the question, the damage to both the company's reputation and permanent way, it is amazing that such a state of affairs should have existed for so many years.

Liability for Tramway Accidents.—In the Huddersfield Corporation tramcars for some time past a stock subject for discussion has been a notice affixed to the seats and to various other prominent positions. By this notice the Corporation seek to put a limit to their responsibility in cases of accident on the cars, &c. On each ticket is also printed the following:—"Issued at reduced fares, and subject to the bye-laws, and on condition that in case of injury from whatever cause arising the total liability of the Corporation shall not exceed £25. Except as above, passengers travel at their own risk." In order to ascertain an opinion which might be regarded of fairly interpreting the law, a resident recently put the case before the *Justice of the Peace*. The reply given in Saturday's issue of that journal is as follows:—"The local authority, being the owners of the tramways and working them are 'promoters' within Sec. 55 of the Tramways Act, 1870, and are, under that section, 'answerable for all accidents, damages, and injuries happening through their act or default, or through the act or default of any person in their employment, by reason of or in consequence of any of their works or carriages.' This being a statutory obligation, the tramway authority cannot limit their liability in the case of passengers in the manner proposed. Even apart from Sec. 55 the tramway authority cannot except or limit their liability for negligence."

The B.A. Meeting at Southport.—This year's meeting of the British Association for the Advancement of Science will be opened on Wednesday week, September 9th. The papers which are already down for reading in the Engineering Section,

over which Mr. Charles Hawksley, Past-President Inst. C.E., will preside, include the following:—

"The Problem of Modern Street Traffic," by Lieut.-Colonel Crompton, R.E., C.B.

"Protective Devices for High Tension Circuits," by W. B. Woodhouse.

"Refuse Destructors and Power Production," by W. F. Goodrich.

"Parallel Running of Alternators," by B. Hopkinson.

"Balancing of large Engines," by J. Perry.

"Pendulum Apparatus for Testing Steel as regards Brittleness," by Captain H. Riall Sankey, R.A.

"A new Form of Mirror Extensometer," by J. Morrow.

"Clutches," by H. S. Hele Shaw.

"Ventilation of Tube Railways," by J. W. Thomas.

"Liquid Fuel," by A. M. Bell.

"The Manchester and Liverpool Express Railway," by F. B. Behr.

"Aluminium as an Electrical Conductor," by J. B. C. Kershaw.

"Electric Traction," by J. N. Shoolbred.

"A further Note on Gas Engine Explosions," by H. E. Wimperis.

"The Single-Phase Repulsion Motor," by W. Cramp.

"Steam Traffic on Common Roads," by T. Clarkson.

"Smoke Abatement," by W. G. Popplewell.

"Illustrations of Graphical Analysis," by J. Harrison.

Report of the Small Screw Gauge Committee.

Report of the Road Traction Committee.

There will also be a paper giving "An account of the Manchester Municipal School of Technology."

Excursions have been arranged to places of engineering interest, including a visit on Saturday, September 12th, to the Manchester Municipal School of Technology, and on the same day to the Works of the British Westinghouse Electric and Manufacturing Co., at Trafford Park.

On Thursday, September 17th, the British Insulated Wire Co.'s Works, at Prescot, will be visited, also the L. & Y. Railway Co.'s Works, at Horwich.

Train Resistance Formulæ.—Our American namesake prints a paper by Mr. J. Balch Blood, read at the June meeting of the American Society of Mechanical Engineers. Mr. Blood discussed the matter in the same place about three years ago. His idea of train resistance formulæ is that each item of resistance should receive separate consideration, and a rational formula should be capable of being constructed therefrom with correct exponents to the variables.

The Eastern Railway of France determined four formulæ for different speeds from extensive experiments, and from these results Mr. Blood concludes that velocity should enter into a rational formula with a fractional index, which he fixes at 1·8, and commends the courage of Mr. Aspinall, who also uses a fractional exponent of 1·66. The head and tail resistance is by no means a constant, and is varied according to the class of car employed. Obviously the value of this coefficient must vary considerably according as the cars are vestibuled or even closely coupled as on the Midland Railway, or coupled in the slovenly manner of ordinary American trains, or some of our own southern lines.

He suggests a formula of the following type:—

$$R = A + BM + \left(C + \frac{D}{T}\right) M^n, \text{ where}$$

R is the resistance in lbs. per ton.

M the speed in miles per hour.

T the train weight in tons (? 2,000 lbs.).

n exponent = 1·8.

A a sliding friction coefficient.

B a rolling " "

C a coefficient of side resistance.

D a coefficient of head and steam resistance, and he finds A varies from three to seven as between freight trains and light electric cars.

B varies from 0·15 to 0·12 for light and heavy track.

C from 0·0016 to 0·0014 for ordinary or vestibuled cars, and D from 0·25 to 0·35 for small cars, and large electric cars, or suburban trains.

The subject is evidently very much in the clouds so far, and whether a purely rational formula will be found eventually that will give better or more reliable results than the better class of empirical formula it is difficult to say.

At present, what is known positively as a result of half a century of practice is that certain locomotives will do certain work, and constructors cannot get far wrong, for every step forward is so small that no change in the design of cars or engines carries one out of sight of their predecessors, while they are known quantities, which form a safe guide to future designers.

Modern Methods of Profit Sharing, &c.—Some articles have been contributed to recent issues of the *Engineering Magazine* by Mr. Kershaw, in which the author gives an interesting picture of the various profit-sharing, or workman-conciliating arrangements that have been devised and put into practice in Great Britain, Germany, and the United States. In Germany attention is mostly bestowed upon the improvement of the social condition of the men's lives rather than upon giving high wages or bonuses. At the machinery works of Ludwig Loewe & Co., in Berlin, lavatories and lockers are provided for the hands, so that they may wash and change their clothes when leaving. The factories are warmed with hot air in winter. At Schuckert's, over and above the legally necessary sick, accident and old age funds, the firm has started a special pension fund by a contribution of £40,000. To this fund all employés on the staff subscribe 4 per cent. of their salaries, the moneys being refunded without interest if the officer should quit his post. All men in receipt of weekly wages become members of the fund after five years' service; they do not contribute. When invalided they receive £1 per month plus 1s. for every extra year's employment above five, the maximum being 50s. per month. After five years any salaried member of the fund is entitled to sick pay equal to 1 per cent. of his last year's salary, plus 2 per cent. (up to 70 cent.) for every additional year. Widows receive half the sum due to their husbands, plus 10 per cent. for every child—this payment continuing during the woman's life. All employés share in the profits after one year's service, the premiums being invested by the firm, if requested, in the municipal savings bank till the amount reaches £25, when it is transferred to the firm's capital and ranks for ordinary dividend. Each workman's share is limited to £100. There is also a co-operative cash supply association; while beer and other light refreshments can be obtained inside the works, the profits going to the men's pension fund. Training schools for mechanics and clerks are carried on by the firm, and baths for the hands have also been built. Mrs. Schuckert has spent £15,000 upon an evening continuation school for the children. At the German Niles Tool Works, near Berlin, very similar arrangements are to be found, each man being allowed half an hour per week in the firm's time for his free bath. There is a dining hall fitted with gas stoves and a canteen; also a surgery with a trained male nurse in charge, situated in the factory. In England we have our Port Sunlight village of 600 semi-detached houses for the 3,000 employés engaged by Lever Bros., also Mr. Cadbury's village at Bournville, and the one at Saltaire. The Bournville scheme is in several respects purely philanthropic, the others may be regarded as simple business speculations, with an admirable non-"pauperising" element of philanthropy thrown in. Mr. Hartley's method at Fazakerley takes the form of distributing a fixed proportion of the profits among the hands in cash at Christmas, the sum received partly depending upon the excellence of the individual's work. Clark, Nickolls & Coombs set aside half their profits after paying a dividend of 6 per cent., giving a portion of the residue in cash, and investing the other as a provident fund against marriage, sickness, or death. The plans adopted by the South Metropolitan Gas Co. and the Thames Shipbuilding Co. are too well known to need further reference. Messrs. Colman, of Norwich, offer to pay a pension of 8s. per week to all those employés in their service aged 65, who have contributed to the fund at least 2d. per week. The men's contributions accumulate at 3 per cent. interest, guaranteed by the firm and increase the 8s. Should a man leave the firm or die before the age of 65, his own contributions plus interest are paid to him or his heirs. At Denny & Co.'s men are paid for useful written suggestions which benefit the firm. Furness, Withy & Co., and Armstrong, Whitworth & Co., have increased their ordinary capital by 500,000 shares, which are offered to the men, the money for the purchase being advanced at 3½ per cent. In the United States, the Bethlehem Steel Co. lay down a fixed time for the completion of each large job, and pay a fixed day wage therefor; any saving in time is rewarded by a bonus or premium. The foremen and under managers are also paid a bonus, which increases with the bonuses earned by their gangs. The National Cash Register Co., of Dayton, Ohio, who employ large numbers of women and girls, have gone in for high-backed chairs and footstools for their sitting hands; lifts, refreshments, dancing schools, a free dispensary, free baths in the firm's time, &c. They claim to get more work done in the 7¾ hours now than formerly in 10. Heintz & Co., of Pittsburg, have similar arrangements, with free working dresses, a brass band, choral and dramatic societies, and roof gardens. Mr. Kershaw proposes to discuss the future of the bonus and premium systems of payment in future articles; at present he seems in favour of the adoption of a modified form of the American system of premium. He appears to like the German social and domestic schemes for benefiting the workers, but remarks that they do not promote output of work as do cash payments. He leans to an immediate system of rewards, stating that "most men (whether workers or capitalists) prefer a pound in the pocket to a post dated cheque on a shaky (*sic*) bank, and would rather receive a premium of 50 per cent. on their income paid weekly than a bonus of 5 per cent., or less, paid annually." Accepting these figures and methods of comparison, it is not altogether surprising if they do so.

The Pecuniary Value of Scientific Research.—In the course of his address upon science and commerce, to which we have elsewhere referred, Sir Philip Magnus remarked how regularly the control of a factory by the highly-trained technical men working on their own lines in a well equipped and properly financed laboratory leads to economy in the cost of production, and to unexpected discoveries, which give birth to subsidiary industries. He also observed how frequently these by-products of experiment prove of more value than the results of the original investigation. These facts have for long been so obvious to technical men that they are mere truisms, but they are commonly ignored implicitly, if not explicitly, by British manufacturers. If the ordinary manufacturer in this country worships at all at the shrine of science, he considers he has sacrificed sufficiently when his laboratory contains just the minimum number of skilled men to test the raw materials, watch over the manufacturing processes, and examine the finished goods: further investigation is a mere waste of time and money. To illustrate the usual result of this short-sighted policy, Sir Philip Magnus does not refer to the aniline dye trade, of which we have heard so much lately, but quotes the glass trade, where the phenomena are similar though less known. Some years ago the manufacture of glass was taken up as a serious scientific study in Germany, in order that, primarily, better material might be made for the use of chemists. The result is, not only that endless varieties of glass having higher softening points and greater resistance to chemical reagents, &c., can be made; but also that other glasses possessing almost any or every property that opticians

and microscope builders require can be produced, some of the properties combined in one sample having been formerly considered antagonistic. The scientific result is that many of the physical properties of a hitherto unmade glass can be predicted from its chemical composition, and that numerous chemical elements practically untouched by the glass maker in this country are regular ingredients in special brands of Jena glass which are largely used for particular purposes; the commercial result is that Germany has "almost a monopoly in the production of lenses and optical instruments." Sir Philip might have added, and of lamp chimneys.

The Industrial Syndicates of Germany.—A report upon German trade has recently been sent home by Mr. Oppenheimer, our Consul-General at Frankfort, in which considerable attention is devoted to the syndicates which permeate so many branches of industry in the Empire. The "trust" proper is practically unknown in Germany: the institution dealt with by Mr. Oppenheimer is the "syndicate," an agency resembling the old guilds which separates producer from buyer, regulating through one central office conditions of sale for a whole branch of manufacture. These syndicates have worked on a high-price policy, running up prices during the last commercial boom in Germany, and inducing customers to sign contracts extending over long periods of time; so that when the last depression arrived, the customers were still practically compelled to buy their raw or semi-finished material at a price out of proportion to that obtained for the completed products. Contrary to some people's expectations, the syndicates have proved themselves able to withstand the times of depression, for they strengthened themselves by granting private export bounties, and by reducing the stocks in the home markets through selling at any price abroad. Some of the syndicates in the Westphalian iron and coal trades have started a clearing house for exports at Düsseldorf, which fixes and liquidates the bonuses. During the March—June quarter of this year there was a bonus of 1·50 marks per ton on the coal and coke used in the manufacture of export goods, and an additional 2·50 upon raw iron. On half-finished iron goods, and upon girders, there was an inclusive bonus of 10 marks per ton. As regards selling at any prices in foreign markets, it is said that the wire-nail syndicated manufacturers recently made a home (German) profit of 1,200,000 marks in six months, but made a loss of 859,000 marks in the same period abroad. Again, iron bars for exports were quoted last September at 80 or even 72 marks f.o.b.; but delivered at Rhenish-Westphalian works, they cost 95 marks. A syndicate's home prices are regulated by the Customs duty, the figure being fixed, after local competition has been extinguished, just low enough to keep out the foreigner. Thus the syndicate policy, it is said, will prevent modern protective duties from benefiting the public of the protected country, as was formerly the case when they still fostered a sound home competition. The syndicated manufacturers refuse to sell to firms who buy from outside manufacturers or from foreigners; and related syndicates also combine, until a syndicated firm refuses to have dealings with any concern which is itself not syndicated. Thus German material can be bought more cheaply abroad than at home, although much of the home stuff is bought to be worked up into exports. Hence in foreign (non-German) markets, goods made outside Germany from German raw or half-finished material compete easily with goods made in the Empire from the same material; and, consequently, the German export trade in finished goods is declining at the expense of that in semi-raw material. The general result is enormously to benefit persons with much capital at their disposal; for the tyranny of the syndicates is such that the manufacturer of finished from partially-finished goods is tempted to make instead of buy, until he eventually owns the works or mines which enable him to deal with absolutely raw material. Syndicates abolish that competition which has led to technical improvements and inventions, and prevents "natural selection" among factories. Nevertheless, syndicates make the capital invested in trade less susceptible to crises, render prices more even and steady, abolish price-cutting, and reduce the expenses of production. They benefit the labour market, steady employment and wages; and if home prices are artificially kept up in times of depression, wholesale dismissal of employés is not necessary, so that the various trades more easily acquire an old and experienced body of workmen.

Carbon Electrodes.—A paper read before the American Electro-chemical Society at its Niagara Falls Convention was entitled "Note on Testing Carbon Electrodes," by Mr. F. A. J. Fitzgerald, who is connected with the International Acheson Graphite Co., of Niagara Falls. Mr. Fitzgerald pointed out, that in both electro-chemical and in electro-metallurgical processes in which carbon electrodes are used, the determination of the density is important, as the general efficiency of the electrode will depend upon the nature of the carbons, and on the methods used in their manufacture. Both the real density and the apparent density should be found, for from these two quantities the porosity may be calculated. The real density was referred to as the density of the carbon of which the electrode is made, while the apparent density is the ratio of weight of the electrode to its volume, taken as a whole. The porosity is the ratio of the difference of the volume of the electrode taken as a whole, and the volume of the carbon of which it is composed, to the volume of the electrode taken as a whole. As amorphous carbons and graphites retain the air, the determination of the real density is difficult. Mr. Fitzgerald described a method in which he used a volumeter fitted with a rubber stopper through which a glass tube is passed, the end of the tube being bent back on itself. The volumeter is placed in a water bath. A specimen to be tested is weighed. The volumeter partly filled with kerosene is placed in the water bath; a reading is taken, the specimen introduced, and the volumeter connected with the vacuum pump. When the maximum attainable vacuum is obtained through the vacuum gauge for a period of 10 minutes, the volumeter is disconnected and a reading taken, after which the operation is repeated and another reading taken. This is continued until two consecutive readings are the same. The difference between the last and the original reading is the real volume of the specimen, from which the real density is calculated.

In order to determine the apparent density, the electrode is given a light coat of shellac and put in the volumeter, which now contains water, and the volume of water displaced is noted. To get at the porosity it is important that the real and apparent densities should be determined from the same specimen, since both these quantities vary in carbons. An average specimen should be obtained.

Mr. Fitzgerald further pointed out that "in certain electrolytic processes the use of amorphous carbon electrodes is unsatisfactory because of their rapid disintegration in the electrolyte. This may be overcome to a certain extent by special methods of manufacture or by using amorphous carbons, such as retort carbon, which show greater resistance to disintegration. Similar remarks apply to the use of carbon electrodes for the electric furnace in metallurgical work. Of all forms of carbon, graphite shows the greatest resistance to oxidising and disintegrating actions; when, therefore, it is possible to use carbon at all, graphite gives the best result. It is obvious, however, that an electrode made like the ordinary graphite brush, such as is frequently used on dynamos and motors, would be of little use, since the graphite particles are held together by a binding material of amorphous carbon, and consequently disintegration would be nearly, if not quite, as rapid as in the use of amorphous carbon electrodes. To obtain the best possible results the electrode should contain no amorphous carbon, and it is, therefore, important to have some method of testing electrodes to determine whether they are composed entirely of graphite."

Carborundum as a Furnace Lining.—Further details as to the employment and value of carborundum as a furnace lining, and as a means of preserving less refractory materials against fire or high temperatures, to which we referred briefly in our issue for December 12th last, have been given in a recent article printed in the German *Zeitschrift für Beleuchtungswesen*. When any object such as a crucible, retort, or furnace is to be treated, the carborundum powder is mixed with one-third its weight of water-glass, and the whole diluted with water until it forms a cream suitable for application with a stiff brush. If, however, the carborundum is likely to come into contact with basic substances, either basic bricks or basic slags, the water-glass is replaced by fireclay, using 85 parts of carborundum to 15 of the clay. It is then laid on the surface which is to be protected just as if it were an oil paint, and in such quantity that it forms a layer 0·5 millimetre thick. To produce a film of the thickness quoted requires about 120 grammes of carborundum per square metre. Brickwork must be thoroughly air-dried before the coating is put on; mortar especially must be as dry as possible, or, on heating, evolution of steam may blow the coating off. Massive structures of brickwork are best heated gently for some time and then permitted to become cool before the "paint" is applied. When the painted surface has been allowed to dry for 24 hours, it is ready for use; but it should be warmed slowly the first time. Gradually the waterglass disappears, and the carborundum remains as a kind of glaze, which is perfectly smooth, does not form a slag with the ash of any fuel, withstands rapid heating and cooling, and does not chip off. The process is available for any furnace or apparatus used in connection with gas or solid fuel firing. At the Düsseldorf Exhibition, a tube-welding furnace was shown, which had been given a 0·5 millimetre coating of carborundum and waterglass. This furnace was worked for 10 hours a day for 6 months, and at the end of that period was in as good condition as at first, no repairs having been called for. A mixture of equal parts of carborundum and fireclay can also be employed to stop any cracks in coal gas retorts, being capable of application while the retorts are still hot. In one experiment two leaky retorts were mended in 3 minutes, and they afterwards lasted for 3 months. If the retorts are to be repaired cold, the usual mixture of carborundum with waterglass should be used, but in other cases that with fireclay is preferable. Porcelain crucibles are, with advantage, coated inside and out with the same protective layer; this makes them last longer than usual, and enables them to bear rapid and frequent changes of temperature. Crucibles for the manufacture of steel are better painted on the outside only.

The Electrification of Gas Works.—It so frequently and unavoidably happens in the course of business, that electrical and gas interests clash, that we experience somewhat of a relief in finding that the autocrat and would-be monopolist of the lighting, heating and power world could benefit directly by the employment of such a, supposedly, inferior medium as electricity. Yet such is the case, as vouched for by Mon. M. P. Sarrazin in a paper prepared for the Société Technique de l'Industrie du Gaz en France. Mr. Sarrazin's apparatus, which is electrically driven, is for the efficient and rapid charging and drawing of the gas retorts. The charging machine consists of an iron carriage travelling on rails, and supporting an operating platform and horizontal charging scoop, to which may be imparted a backward and forward motion, or a vertical motion. Supported above the carriage is a supply hopper holding upwards of 5 tons of coal, from which the scoop is filled preparatory to charging the retorts. Two 1-H.P. motors operate the scoop in a horizontal direction, a third motor of 3 H.P. works the travel of the whole apparatus, and a fourth motor of similar size operates the vertical movements of the platform and the scoop. Each scoop can contain 616 lbs. of coal. According to the speed of the motors, the charging of the scoop take about 8 seconds, its insertion and com-

plete withdrawal about 10 seconds, the travelling from one retort to the next about 3 seconds, travelling up and down to the next row of retorts about 4 seconds, in all about 25 seconds. For the exact placing of the machine about 20 seconds is allowed, making 45 seconds for everything, at which rate 80 retorts could be charged in the hour.

The drawing or discharging machine is very similar to the charging device, but of heavier construction. Instead of the scoop a drawing rake is provided, and two electric motors of 1 H.P. each provide the necessary power. Three rakings and movement from one retort to another do not take more than 40 seconds, so that 80 to 90 retorts can be drawn by this machine in an hour. If the two machines deal with an average of 60 retorts per hour, they can handle 259 tons of coal per day, with 3·6 cwt. charges. For a works dealing with 259 tons a day by hand, 26 day and 26 night shift men would be required, allowing two stokers to three benches of nine retorts. With these machines the author states that two night and two day men, with four other men to attend to the retort doors, &c., would be all that are required. The difference in cost would be 44 men at, say, 57·6d. a day, or £3,840 a year, less the cost of electrical energy for the motors, taken at £240, or a saving of £3,600 per annum, without taking into account the advantages of rapid and regular charging. It will now only be necessary to introduce electrically-heated retorts to complete a revolution in gas making.

The Speed of Motor-Cars.—The Society of Motor Manufacturers and Traders has sent the following letter to the Public Control Committee of the London County Council:—"Sir,—I am directed to bring to your notice the very considerable injury to the automobile industry and the great and unnecessary inconvenience to owners and drivers of motor vehicles which would inevitably result should the speed of these vehicles be restricted to a maximum of 10 miles per hour in the County of London, as might possibly be effected under the new Act. The rate of speed attained by horse-drawn vehicles in London frequently exceeds 10 miles per hour, as has been demonstrated by accurate speed tests, the results of which have recently been published in the automobile and daily Press, and from which it appears that even omnibuses not infrequently exceed that speed. Moreover, electric trams commonly travel up to 16 and 17 miles per hour within the County of London, and as the Prime Minister has pointed out, motor-cars are more under control and less dangerous than trams running on fixed rails, and so unable to change their course for other traffic.

"Motor omnibuses and cabs, as well as delivery carts, are now being placed upon the streets of London, and their extended use would go far to solve the problem of congested traffic, besides offering to the public greatly improved travelling facilities; but should a speed of 10 miles per hour be enforced against these vehicles, their usefulness will be considerably curtailed, and both automobile manufacturers and the public will suffer, as well as their proprietors. As has been conclusively demonstrated, the power of control over motor vehicles is so absolute that at the (maximum legal) speed of 20 miles per hour, where traffic permits, they are more under control and less dangerous than horse-drawn vehicles at 12 miles per hour, which speed was shown by the observations above referred to to be exceeded even in so frequented a thoroughfare as Victoria Street, Westminster, in the middle of the day. Moreover, it is impossible for either the driver or an observer to estimate exactly the speed of a vehicle, so that, in effect, in order to avoid incurring the danger of the heavy penalties imposed for a technical breach of this speed regulation, motor vehicles would be reduced to proceed so slowly as to frequently become an absolute obstruction. At slow speeds, too, the noise is greatly increased.

"The absence of wear and tear of the roads caused by motor vehicles as compared with horse traction, the less space occupied, and their greater handiness and cleanliness, should make their universal use an object of interest to all concerned, and experience in London has shown that accidents with these vehicles are very rare, not one fatal accident having occurred in the whole of the Metropolitan police district last year. The interests involved are so considerable that I am directed to inquire if your Committee will agree to receive a deputation from this Society upon the subject.—I am, Sir, your obedient servant,

"(Signed) T. F. WOODFINE, Secretary."

[We have referred to this communication briefly in our leader pages to-day.]

Glasgow University.—The new session at the James Watt Laboratories commences on October 15th. An announcement respecting the Sandwich system of engineering training is given among our Educational advertisements to-day.

Appointments Vacant.—A demonstrator and lecturer in electrical engineering is wanted for the South-Western Polytechnic at £150 per annum; also an assistant for the Electrical Laboratory at the Holt School of Science, Tranmere. See our advertisement pages to-day.

Personal.—The governors of the Hackney Institute have made the following appointment:—Head of the Physics and Electrical Engineering Department, Alfred Hay, D.Sc., F.P.S., M.I.E.E., Professor of Electric Technology and Physics at the Royal Indian Engineering College, Cooper's Hill. The Institute will commence work next session at the new buildings in Hackney Downs, close to Hackney Downs Station.

THE CENTRAL STATION ENGINEER.

THE employés of the Urban Electric Supply Co., who have lately been engaged constructing the electric tramway track at Glossop, presented Mr. J. E. EDMUNDSON, the assistant engineer, on the occasion of his marriage, with a clock and ornaments, also a biscuit barrel Several silver gifts were also presented by the office staff and friends. Mr. Edmundson's new sphere of labour is Scarborough, where he has become resident engineer for Edmundson's Electricity Corporation, Ltd.

Mr. C. J. TURNER, who has lately held an appointment at the generating station of the Islington Corporation, has been appointed assistant electrical engineer to the Hoylake and West Kirby District Council, Cheshire.

NEW COMPANIES REGISTERED.

Körting Bros., Ltd. (78,308).—This company was registered on August 13th, with a capital of £50,000 in £5 shares, to acquire the business of electrical, mechanical, hydraulic, gas, heating and ventilating engineers, carried on by B. Körting and E. Körting in the United Kingdom and the Isle of Man, under the style of "Körting Bros." and to carry on the same, and the business of manufacturers of and dealers in machinery, apparatus and appliances, managers of or agents for other companies and firms, owners of patents and inventions, &c. The first subscribers (each with one share) are:—O. Lindemann, 53, Victoria Street, S.W., engineer; Mrs. M. Lindemann, 16, Chestnut Road, West Norwood, S.E.; Miss C. Lindemann, 16, Chestnut Road, West Norwood, S.E.; K. Lindemann, 39, Deronda Road, Herne Hill, S.E., engineer; Miss M. Oertling, 16, Chestnut Road, West Norwood, S.E.; G. A. Diener, 77, Watling Street, E.C., merchant; and H. Russell, 12, York Road, West Norwood, S.E., engineer. No initial public issue. The number of directors is not to be less than three nor more than seven; the first are B. Körting, W. Körting, W. Fricke, O. W. Foth and O. Lindemann; remuneration (except managing director), £50 each per annum. Registered office, 53, Victoria Street, S.W.

Electro Institute, Ltd. (78,325).—This company was registered on August 15th, with a capital of £6,000 in £1 shares, to carry on the business of medical electric specialists, manufacturers of and dealers in medical and electrical curative appliances, chemists, druggists, manufacturers and vendors of special medicines and remedies, proprietors of institutes for the medical and electrical treatment of diseases, &c. The first subscribers are:—T. P. Wayte, Egginton, Burton-on-Trent, gentleman, 1,000 shares; W. E. Fisher, 84, Charing Cross Road, W., gentleman, 1 share; H. C. Fowler, 69, Grosvenor Park, Kennington, S.E., clerk, 1 share; E. H. Walker, 35, College Hill, E.C., accountant, 1 share; J. Puttfarcken, 37, Walbrook, E.C., merchant, 1 share; F. R. Parish, 39, Clarence Road, Kentish Town, N.W., clerk, 1 share; and C. A. Henderson, 25, College Hill, E.C., gentleman, 1 share. No initial public issue. The first directors are T. M. Perkins and W. E. Fisher; qualification, 50 shares; remuneration as fixed by the company. Registered office, 26, Charles Street, Haymarket, W.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

New General Traction Co., Ltd. (47,321).—This company's annual return was filed on July 17th, when the entire capital of £370,000 in 50,000 preference and 24,000 ordinary shares of £5 each had been taken up. £250,000 has been paid on 50,000 shares, and the remaining 24,000 are considered as fully paid. Mortgages and charges: £228,375 (£181,300 debentures and £47,075 loans).

Callender's Cable and Construction Co., Ltd. (48,915).—This company's annual return was filed on June 30th, when 35,000 ordinary and 40,000 preference shares had been taken up out of a nominal capital of £600,000 in 60,000 ordinary and 40,000 preference shares of £5 each. £5 per share has been called up on 15,000 ordinary and 40,000 preference shares, resulting in the receipt of £275,000. £100,000 considered as paid on 20,000 ordinary shares. Mortgages and charges: £200,000.

British Shuckert Electric Co., Ltd. (59,762).—This company's annual return was filed on June 30th, when the entire capital of £200,000 in 20,000 shares of £10 each had been taken up. £2 per share has been called up, resulting in the receipt of £40,000. No mortgages or charges.

Harrington Electric Light Co., Ltd. (44,135).—This company's annual return was filed on June 10th, when 3,900 shares had been taken up out of a nominal capital of £5,000 in £1 shares. £1 per share has been called up on 3,000, and 10s. on 900, resulting in the receipt of £3,450. No mortgages or charges.

A. Hirst & Son, Ltd. (57,889).—This company's annual return was filed on June 9th, when 100 preference and 310 ordinary shares had been taken up out of a nominal capital of £5,000 in £10 shares (100 preference). £10 per share has been called up on 100 preference and 10 ordinary, resulting in the receipt of £1,100. £3,000 considered as paid on 300 ordinary shares. Mortgages and charges: £2,000.

Crystal Palace District Electric Supply Co., Ltd. (18,532).—Issue on July 14th of £10,000 debentures, part of a series created December 1st, 1898, to secure £50,000, charged on the company's undertaking and property, present and future, including uncalled capital, subject to £10,000 prior lien bonds. Trustees:—J. I. Courtenay, 1, Essex Court, E.C.; and G. B. Voules, The Admiralty, S.W. Previously issued of same series: £40,000.

W. T. Glover & Co., Ltd., electric wire and cable manufacturers, Manchester (56,124).—Issue on June 30th of £8,500 5 per cent. second debentures, part of a series created by resolution of preference shareholders dated March 27th, 1902, to secure £100,000, charged on the company's undertaking and property, present and future, including uncalled capital, subject to first mortgage debenture stock. Holders: J. Lawson and A. L. Ormrod, both of 10, Half Moon Street, Manchester; and G. B. Samuelson, 2, Queen Anne's Gate, S.W. No trustees. Previously issued of same series: £90,500.

Auckland Electric Tramways Co., Ltd. (61,199).—A trust deed dated July 14th, 1903, to secure £200,000 debenture stock created by resolution of July 7th, 1903 (the company having power to issue further stock ranking *pari passu* up to the amount of its subscribed capital), has been registered. Property charged:—(Specifically): certain concessions, lands, buildings and premises. (As a floating security): the company's undertaking and property, present and future, except certain assets specified in deed. The company further undertakes to seek the necessary consent to charge, and thereupon to charge certain other concessions. Trustees:—Electric and General Investment Co., Ltd., 1—2, Great Winchester Street, E.C.

Bastian Meter Co., Ltd. (70,309).—Issue on July 29th of £650 debentures, part of a series created by resolutions of April 22nd, May 23rd, and June 10th, 1901, to secure £6,000, charged on land and buildings at Kentish Town (24, Bartholomew Villas), and the company's other assets, present and future, including uncalled capital. Trustees:—H. A. Saunders, Chesterfield; and D. J. Cowles, Manor House, Felixstowe. Previously issued of same series: £4,700.

Harwich Electric Lighting and Tramways Company, Ltd.—This company's returns for 1901 and 1902 were filed on May 12th, 1903. Seven shares have been taken up out of a nominal capital of £50,000 in £1 shares, and nothing has been paid thereon. No mortgages or charges.

T. C. Welding & Co., Ltd., electric fittings manufacturers, Liverpool (53,304).—Issue on July 9th of £300 third mortgage debentures, part of a series created same date to secure £1,500, charged on the company's undertaking and property, present and future, including unpaid capital. No trustees.

Ferranti, Ltd. (70,868).—This company's annual return was filed on June 27th, when 120,000 preference and 100,000 ordinary shares had been taken up out of a nominal capital of £400,000 in £1 shares (200,000 preference). £1 has been called up on each, resulting in the receipt of £220,000. Mortgages and charges: £100,000. (Further debentures for £30,000 subsequently registered.)

Bright's Light and Power Co., Ltd. (58,293).—A debenture for £2,000, created July 31st, 1903, charged on the company's concessions, freehold and leasehold property, works and plant in England or elsewhere, and (as a floating security) all its assets, including uncalled capital, has been registered. Holder:—C. Owles, 16—17, Russell Street, W.C.

Woking Electric Supply Co., Ltd. (46,175).—Issue on July 25th of £50 and on July 27th of £100 debentures, part of a series created November 2nd, 1899, to secure £25,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Previously issued of same series: £22,000.

ELECTRICITY SUPPLY ACCOUNTS.

Greenock Municipal Electricity Accounts.

The annual report of the Greenock undertaking compares the 12 months ending June 30th, 1903, with the previous 18 months' figures. The output during the latter period considerably exceeded the previous 18 months' total, which, with decreased costs of production, due to the excellent load factor, has contributed to the earning of a gross profit equivalent to 6·8 per cent. per annum, as compared with only 4·4 per cent. in the earlier period. The large increase in output is partly due to the traction supply taken by the Greenock and Port Glasgow Tramways Co. having been fully developed, but the private lighting and power supply has also increased by 55 per cent. The prices charged are:—For private lighting 7d., and 1½d. on the maximum demand system, or a flat rate of 5½d.; for power, 2d.; and for traction, 1½d. per B.T.U. There are 50 public arc lamps and 49 motors totalling 500 H.P. on the system.

The borough electrical engineer during the period under review was Mr. J. A. Robertson.

GENERAL STATEMENT.

For periods ending June 30th—	18 months. 1902.	12 months. 1903.	Increase.
Total capital expended	£69,537	£80,206	£10,669
Number of Units Generated—			
Traction	468,038	781,803	313,805
Lighting	471,908	482,129	10,221
Total	939,946	1,263,972	324,026
Equivalent number of 8-C.P. lamps connected	33,340	41,955	8,615
Maximum load in KW.	600	710	110
Load factor	12·00	20·3	8·3
Revenue Account—			
Gross revenue	£11,022	£12,359	£1,337
„ expenditure	£5,946	£6,868	£922
„ profit	£5,076	£5,491	£415
Average price obtained for private lighting	3·6d.	3·7d.	·1d.
Average price obtained for traction	1·5d.	1·5d.	·00d.

The total revenue for the period ending June 30th, 1903, amounted to £12,359, equivalent to 2·35d. per unit, as compared with £11,022, or 2·67d. per unit for the previous return.

The works costs show reductions in all items, except repairs and rates and taxes. Fuel has cost ·57d., against ·67d. per unit last year, and judging from the load factor, and locality of the works, this figure and the present total costs of 1·31d. per unit should be greatly improved during the next year or two.

COST OF PRODUCTION.

	1901-2 (18 months). Gross.	Per unit.	1902-3 (12 months). Gross.	Per unit.	Inc.
Coal and other fuel, including cartage	£2,621	·67d.	£3,012	·57d.	—·10d
Oil, waste, water and engine-room stores	338	·08d.	290	·05d.	—·03d.
Wages of workmen at station ..	905	·23d.	1,057	·20d.	—·03d.
Repairs	187	·05d.	412	·08d.	—·03d.
Distribution and public lighting ..	662	·17d.	574	·11d.	·06d.
Works and distribution costs	£4,713	1·20d.	£5,345	1·01d.	—·19d.
Management	712	·19d.	659	·14d.	—·05d.
Rent, rates, taxes and insurance..	521	·13d.	864	·16d.	·03d.
Total works cost	£5,946	1·52d.	£6,868	1·31d.	—·21d.

The net result of the year's work after paying all charges including interest and sinking fund, is a surplus of £649, compared with a deficit of £1,367 in the previous 18 months.

PROFIT STATEMENT.

	18 months, 1902.	12 months, 1903.
To interest on loans	£2,769	£2,175
Sinking fund	3,674	2,666
Net profit or loss	—1,367	650
Gross profit	£5,076	£5,491

Chesterfield Municipal Electric Supply.

The first complete 12 months' work of the Chesterfield electrical department is chiefly of note for the exceptionally low fuel costs which have been obtained, and which has brought down the works costs to such a creditable figure for an undertaking with only 200,000 units output, and a load factor under 9 per cent. With a total works cost of 1·37d., and an average price of 4¼d. (nearly) per unit, it will be seen that an ample margin of gross profit, equivalent to 7½ per cent. on the capital exists, with which to meet capital charges, and the result for the period under review is a surplus of £827. The charges are, for private lighting, 6d. and 3d. on the maximum demand system, and 1½d. per B.T.U. for power. The department appears to be well situated, both as regards fuel and water, and as the moderate charges promise to attract numerous power consumers in the neighbourhood, there is every possibility of the electrical engineer, Mr. R. L. Acland, being able to continue the excellent results of the past year.

GENERAL STATEMENT.

For year ending March 31st, 1903.

Total capital expended	£33,117
Number of units supplied:—	
Private lighting...	167,233
Public lighting	28,638
Power and heating	12,445
Total	208,316
Equivalent number of 8-C.P. lamps connected	17,000
Number of public lamps	20 arcs. 40 incndt.
Number of motors and horse-power	20 = 146 H.P.
Revenue account:—	
Gross revenue	£3,671
Gross expenditure	£1,194
Gross profit	£2,477
Average price obtained for public lighting ...	1·07d. per unit.
„ „ „ for private lighting ...	4·60d. „

REVENUE STATEMENT.

	Gross.	Per unit.
By sale of energy	£3,559	4·10d.
Motor and meter rents	112	·13d.
Gross revenue	£3,671	4·23d.

WORKING EXPENSES.

	Gross.	Per unit.
Coal and other fuel	£249	·29d.
Oil, waste, water and engine room stores ...	37	·04d.
Wages incurred in generation and distribution	215	·25d.
Repairs and maintenance of buildings, plant, &c.	136	·15d.
Works and distribution costs	£637	·73d.
Public lamps, attendance and repairs	72	·08d.
Rent, rates and taxes	124	·14d.
Management expenses, salaries of engineer, clerical staff, &c., printing, stationery and general expenses	361	·42d.
Total works costs	£1,194	1·37d.

PROFIT STATEMENT.

To interest on sinking fund instalment	£1,265
To bank interest	385
Net profit on year's working	827
Gross profit	£2,477

The year's working has resulted in a surplus of some £827, which was added to the net profit of 1902 (£213), and the total amount, £1,040, allocated as follows:—Preliminary expenses, £405; cost of engineer's house, £392; exhibition, £39; reserve fund, £204.

CITY NOTES.

Dublin and Lucan Electric Railway Co.

The half-yearly meeting was held on the 20th inst., Mr. James W. Hill presiding. The Chairman said that, as compared with the corresponding half of last year, the receipts showed an increase of £60 on passengers and £80 on goods traffic, and a decrease on parcels and sundries of £17. That made a net increase of about £61. The expenditure showed an increase on maintenance of £39, on motive power of £71, on repairs of carriages and wagons of £39, and on traffic expenses of £27, which, with other items, made a total of £217. This was, unfortunately, further increased by £137, the cost of rebuilding a boundary wall. The net increase was only £167. After providing for debenture interest, there was a balance of £837 available for dividend, out of which it was proposed to pay 5 per cent. on the preference shares, add £300 to the suspense account, and carry forward £62 10s. 7d. to the next half year. The weather had been very much against them, and had more or less interfered with their traffic, yet there had been an increase of £60 on the passenger traffic, and a favourable summer would have added considerably to that.

Captain Vesey seconded the adoption of the report, which passed unanimously.

Mather & Platt, Ltd.

The report for the year ended June 30th states that net profits, after charging depreciation and the amount of directors' remuneration, are £83,934, which, with the balance, £17,092, brought forward from June, 1902, gives a total of £101,027. The preference dividend paid on March 1st last for the half-year to December 31st, 1902, absorbed £8,126, leaving for disposal £92,900. The directors recommend a dividend of 7 per cent. per annum on the ordinary shares for the year; to transfer to reserve account (bringing up the amount, with the new share premiums, to £150,000), £36,252; transfer for special depreciation, £10,000; carried forward to next account, £10,209.

Tyneside Tramways and Tramroads Co.

The half-yearly meeting was held at the company's offices, Newcastle-on-Tyne, on 24th inst., Lord Armstrong presiding. The directors' report for the half-year ending June 30th, 1903, showed that the surplus of receipts over expenses amounted to £1,198, which, together with the balance carried forward from last year of £233, made a total to the credit of the profit and loss account of £1,431. Out of this the directors proposed the payment of a dividend of 2 per cent. per annum, less income-tax, which would leave £327 to be carried forward. The extension between St. Nicholas' Church and the High Street, Gosforth, was opened for traffic on April 10th. The traffic receipts showed steady and satisfactory increase. The directors had authorised the construction of the line along the North Road to Gosforth Park, and for this work plans and specifications were now being prepared. The Chairman, in moving the adoption of the report, said their first complete half-year of operation was satisfactory, and indicated material progress. This they would appreciate by a comparison of traffic returns. The receipts for the last week in 1902 were £293, whereas during the Whitsuntide week this year their receipts amounted to £626, while on an ordinary week, without holidays, they reached as much as £395, and since the report was issued they had done even better. In regard to the interchange of traffic, he was pleased to state that the Tynemouth Tramways Co. had now obtained a Bill to enable them to lay a third rail from Borough Road, North Shields, to the terminus of the Tyneside system in that place to facilitate the transfer of passengers. An endeavour was also being made to get mutual running powers with the Newcastle-on-Tyne Corporation, Wallsend Corporation having urged the necessity of this being done.

Dr. Merz seconded the adoption of the report, which was agreed to.

A formal resolution for the payment of the dividend having been passed, a vote of thanks was passed to the Chairman.

Dr. Spence Watson, who proposed the vote, congratulated the Chairman on his elevation to the peerage.

Stock Exchange Notices.—The Committee has (1) appointed special settling days as under:—Wednesday, September 2nd—County of London and Brush Provincial Electric Lighting Co., Ltd., provisional certificates (fully and partly paid) for £250,000 4½ per cent. second debenture stock. Thursday, September 10th.—British Westinghouse Electric and Manufacturing Co., Ltd., further issue of 100,000 6 per cent. preference shares of £5 each, fully paid, Nos. 375,001 to 475,000. And (2) ordered the undermentioned securities to be quoted in the Official List:—British Westinghouse Electric and Manufacturing Co., Ltd., further issue of 100,000 6 per cent. preference shares of £5 each, fully paid, Nos. 375,001 to 475,000; County of London and Brush Provincial Electric Lighting Co., Ltd., provisional certificates (partly paid) for £250,000 4½ per cent. second debenture stock; Edmundson's Electricity Corporation, Ltd., further issue of 20,000 ordinary shares of £5 each, fully paid, Nos. 50,001 to 70,000.

British Insulated & Helsby Cables Co.—Interim dividend on ordinary shares, 8 per cent. per annum.

Hadfield's Steel Foundry.—The directors have paid an interim dividend of 1s. per share in respect of the current year.

STOCKS AND SHARES.

Wednesday Evening.

Money, to quote the orthodox financial journalists, is a drug in the market. Consols and other investment departments are accordingly on the rise, although the possibility of a 4 per cent. Bank Rate in the near future is still with us. That chance, however, is conveniently forgotten, and after chronicling depression for several weeks, there comes a certain amount of satisfaction in being able to point to more cheerful conditions. The Home Railway market begins to assume a less lugubrious appearance. Investors are apparently noting the cheapness of securities in this department, and at the End August settlement a good deal of real stock was taken up by outsiders, as distinct from the financial pawnshops. Even the electric railway section has got over the worst of its scare. The other markets which fall under our scope are steady, so steady that the number of fluctuations this week number less than half a score.

City and South London Railway Ordinary has rallied from its weakness, and now records a small gain since we last wrote. When a few nervous proprietors had finished throwing away their holdings the market took a turn for the better, especially as it was recognised that weight attached to the contention which explained a few traffic decreases by the consideration that a year ago London was full of Coronation visitors. The "Twopenny Tube" trio continues unaltered, the Ordinary having recovered a small loss. It may happen that Central Londons will keep dullish for some time to come in view of the advancing electrification of the two underground systems, yet, for all that, the company will probably be able to maintain its regular 4 per cent. dividends, and at anything below par the stocks look reasonably cheap.

Notwithstanding the progress just mentioned, District Ordinary remains beneath a cloud, although Metropolitan shows signs of revival. Of course the general public will be chary of purchasing any tunnel stocks for a while, and it is still possible that lower quotations may be seen, unlikely though we are inclined to think it. The British Thomson-Houston having obtained the contract for the electrification of the District line, a good many inquiries are afloat in reference to the company. It must be prefaced that for the shares of the British Thomson-Houston there is no market at all, but the 4½ per cent. Debenture stock is occasionally dealt in, the nominal price just now being about 106. This is a premium of two points above the figure at which Messrs. J. S. Morgan & Co. offered the stock last March twelvemonth, they having purchased it previously. It is redeemable at the company's option in nine years' time at 105, and there is £200,000 of the stock outstanding, one-third of the total amount authorised. The share capital consists of £800,000 in £10 fully-paid shares divided equally into Preference and Ordinary, and the dividends on the latter dwindled from 10 per cent. in 1900 to 4 per cent. for 1901-2 (15 months).

British Westinghouse Preference are quiet at 5⅞ and the Debenture stock is 101. The Ordinary shares stand at 7 to 7½, so that the charitable individual who is offering small lots of shares to proprietors, at 8½, could easily replace his investment at a handsome profit, if any of the circularised folks are imprudent enough to accept the generous proposal.

British Electric Traction Ordinary are a ¼ better, at 12 middle, which is the same price as that quoted for London United Tramways Preference, the last-named not being affected by the lengthy interview which one of the papers secured with Mr. Clifton Robinson. Anglo-Argentine Trams remain a good market, and cannot be bought much below 4⅜, nor do we see any necessity of realisation for those who picked them up at the time it was here suggested that the shares were worth having at 4¼ or 4$\frac{5}{16}$.

In the Telegraph list a slight fall has reduced Anglo-American Preferred stock to 91, on the prospect of competition from a fresh quarter. Whatever may be in future store for the company, the receipts should benefit considerably from the yacht races, even though the interest aroused in the contests has certainly fallen, at least in the Metropolis, as compared with that aroused over last series. West India and Panama shares eased off a shade on the fear that the Jamaica cyclone may affect the cables, while Eastern Telegraph Preference has risen a point upon investment demand, the stock paying all but 4 per cent. at its current quotation. National Telephone issues are exhibiting a little more animation, but the only quotable change is a point drop in the price of the Deferred Stock. Telegraph Constructions continue to harden.

Amongst electric lighting issues, the new Metropolitan Preference improved to 6s. 3d. premium, which is 6s. more than many people were only too thankful to get for their "rights" when the shares were issued a little while ago. Westminster Ordinary at 12½ are the fraction better, providing the only change in this section on the week. Several interesting special Settlements are to take place, the new Edmundson's Ordinary, for instance, County Second Debenture and British Westinghouse new Preference. Admission to the Stock Exchange Official List will follow in due course.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1900.	1901.	1902.	Closing Quotations Aug. 19th.	Closing Quotations Aug. 26th.	Business done week ended Aug. 26th, 1903. Highest	Lowest
67,100	African Direct Telegraph, 4 % Debs.	100	..	..	..	98 —102	98 —102	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	..	..	..	2¼— 3⅛	2¼— 3⅛	..	..
119,700£	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	..	..	..	70 — 80	70 — 80	..	..
788,840	Anglo-American Telegraph	Stock	3½%	61s.	60/6	47 — 50	47 — 50	..	..
3,105,580	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6 %	91 — 93	90 — 92	92¼	90½
3,105,580	Do. do. do. Deferred	Stock	5s. %	2s.	1/-	8 — 8¼	8 — 8¼	..	..
44,000	Chili Telephone, Nos. 1 to 44,000	5	5 %	5 %	6 %	4⅜— 5⅛	4⅜— 5⅛	..	..
13,333,300$	Commercial Cable	$100	8 %	8 %	8 %	150 —160	150 —160	..	..
1,841,209	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	..	..	..	92 — 95	93 — 96	93⅞	93
16,000	Cuba Telegraph	10	4½%	4 %	6½%	7 — 8	7 — 8	..	..
6,000	Do. 10 % Pref.	10	..	..	..	17 — 18	17 — 18	..	..
12,981	Direct Spanish Telegraph	5	4 %	4 %	4 %	2½— 3⅛	2½— 3⅛	..	..
6,000	Do. do. 10 % Cum. Pref.	5	..	..	..	7 — 8	7 — 8	..	..
30,000	Do. do. 4½ % Debs.	50	..	..	..	97 —101 %	97 —101 %	98	..
60,710£	Direct United States Cable	20	3½%	3½%	3½%	10 — 10⅛	10 — 10⅛	10⅛	10⅛
87,800	Direct West India Cable, 4½% Reg. Deb., within Nos. 1 to 1,900, Red.	100	..	..	..	99 —102	99 —102	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	124 —129	124 —129	127⅛	124¼
1,955,565	Do. 3½ % Pref. Stock	100	..	..	..	89 — 92	90 — 93	..	..
1,534,645	Do. 4 % Mort. Deb. Stock Red.	Stock	..	..	..	105 —108	105 —108	107⅛	106¾
800,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	12 — 12½	12 — 12½	12¼	12
320,000£	Do. 4 % Deb. Stock	Stock	..	..	..	104 —107	104 —107	..	..
300,000	Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 3,000, red. 1909	100	..	..	..	98 —101	98 —101	99	..
200,000£	Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 8,000	25	..	..	..	100 —103 %	100 —103	..	..
180,227	Globe Telegraph and Trust	10	5½%	5½%	..	9 — 9¼	9 — 9¼	9⅛	..
180,042	Do. do. 6 % Pref.	10	..	..	..	12¾— 13¼	12¾— 13¼	13⅛	12⅞
150,000	Great Northern Telegraph, of Copenhagen	10	15 %	15 %	12½%	22 — 23	22 — 23	..	..
62,500£	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	..	..	..	99 —102	99 —102	..	..
17,000	Indo-European Telegraph	25	10 %	10 %	10%	36 — 39	36 — 39	38¾	38½
100,000£	London Platino-Brasilian Telegraph, 6 % Debs.	100	..	..	..	100 —104	100 —104	..	..
1,983,333	National Telephone, Pref. Stock	100	5 %	5 %	6 %	100 —102	100 —102	102¾	100½
1,966,667	Do. do. Def. Stock	100	..	..	4¾%	79 — 81	78 — 80	78¾	..
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	..	..
2,250,000	Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000	5	5 %	5 %	5 %	5 — 5¼	5 — 5¼	..	..
000,000£	Do. do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	96 — 98	96 — 98	..	..
600,000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	101 —103	101 —103	102½	..
171,504	Oriental Telephone and Elec. Nos. 1 to 171,504, fully paid	1	6 %	6 %	6 %	1/16— 1/8	1/16— 1/8	..	..
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	..	..	..	97 —100	97 —100	..	..
11,889	Reuter's	8	5 %	5 %	..	6½— 7⅞	6½— 7⅞	..	..
3,303	Submarine Cables Trust	Cert.	..	..	..	116 —121	116 —121	..	..
58,000	United River Plate Telephone	5	7 %	7 %	7 %	5½— 6	5½— 6	..	..
40,000	Do. do. 5 % Cum. Pref., Nos. 1 to 40,000	5	..	..	..	4⅞— 5⅛	4⅞— 5⅛	..	..
179,947£	Do. do. 5 % Debs.	Stock	..	..	..	104 —107	104 —107	..	..
15,609	West African Telegraph, Shares	10	..	..	2 %	5 — 6	5 — 6	..	..
150,000£	West Coast of America, 4% Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	..	..	..	95 — 98	95 — 98	..	..
267,980	Western Telegraph, Ltd., Nos. 1 to 207,980	10	7 %	7 %	..	12 — 12½	12 — 12½	12⅜	12⅛
75,000£	Do. do. 5 % Debs. 2nd series, 1906	100	..	..	..	100 —103	100 —103	..	..
400,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	97 —100	97 —100	99⅛	99
88,321	West India and Panama Telegraph	10	2½%	..	..	⅞— 1	7/8— 1	..	..
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	..	..	..	6¾— 7	6¾— 7	6⅞	..
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	..	..	..	3¾— 4⅛	3¾— 4⅛	..	..
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	..	..	..	98 —101	98 —101	101	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

20,000	British Aluminium 7 % Cum. Pref.	10	..	..	..	3 — 4	3 — 4	..	..
300,000£	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	..	..	..	78 — 81	79 — 85	..	..
100,000	British Electric Traction	10	9 %	9 %	8 %	11½— 12	11½— 12½	12⅝	12
100,000	Do. do. 6 % Cum. Pref.	10	..	..	..	11½— 12½ xd	11½— 12½	12	11½
600,000£	Do. do. 5 % Perpetual Debenture Stock	Stock	..	..	..	122 —125	122 —125	..	..
100,000	British Insulated and Helsby Cables	5	15 %	10 %	10 %	6⅞— 7⅛	6⅞— 7⅛	..	..
100,000	Do. do. 6 % Cum. Pref.	5	..	..	..	5⅛— 5⅜	5⅛— 5⅜	..	..
50,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	..	..	..	102 —106	102 —106	..	..
50,000	¶Browett, Lindley & Co., Ord.	£1	8 %	Nil	..	1/16— 1/8	1/16— 1/8	..	..
50,000	¶ Do. do. 6 % Cum. Pref.	£1	6 %	6 %	..	14/6 to 15/6	14/6 to 15/6	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731	2	5 %	Nil	Nil	¾— 1½	¾— 1½	..	..
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	3 %	6 %	1 — 1⅝	1 — 1⅝	..	..
125,000£	Do. do. 4½ % Perp. Deb. Stock	Stock	..	..	..	99 —102	99 —102	..	..
125,000£	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	..	..	..	85 — 90	85 — 90	..	..
35,000	Callender's Cable Construction shares	5	15 %	20 %	15 %	11½— 12½	11½— 12½	..	..
40,000	Do. do. do. 5 % Cum. Pref.	5	..	..	..	5⅛— 5⅜	5⅛— 5⅜	..	..
90,000£	Do. do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	..	..	..	106 —110	106 —110	..	..
1,860,014	Central London Railway, Ord. Stock	Stock	..	4 %	4 %	98 —101 xd	98 —101	99	98⅜
494,098	Do. do. 4 % Pref. Stock	Stock	..	4 %	4 %	99 —102 xd	99 —102	102	..
494,998	Do. do. Def. do.	Stock	..	4 %	4 %	101 —104	101 —104	..	..
1,330,000	City and South London Railway	Stock	1½%	2 %	3½%	58 — 60	59 — 61	60	59
85,000	Crompton & Co., Nos. 1 to 85,000	8	8 %	7½%	..	2 — 2⅛xd	2 — 2⅛	..	..
100,000£	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red.	..	..	..	..	101 —105	101 —105	..	..
99,261	Edison & Swan United Elec. Light, "A" shares, £3 paid, 1 to 99,261	5	2½%	Nil	..	0 — ⅛	0 — ⅛	..	..
17,139	Do. do. "A" shares, 01—017,139	5	2½%	Nil	..	1⅛— 2⅛	1⅛— 2⅛	..	..
344,023£	Do. do. 4 % Deb. Stock Red.	100	..	..	..	71 — 75	71 — 75	..	..
100,000£	Do. do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	..	..	..	75 — 80	75 — 80	..	..
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	6 %	1⅛— 1⅜	1⅛— 1⅜	..	..
31,890	Do. do. 7 % Cum. Pref., 1 to 31,890	2	..	..	..	2⅛— 3	2⅛— 3	..	..
82,500£	Do. do. 4 % Perp. 1st Mort. Deb. Stock	Stock	..	..	..	99 —102	99 —102	99	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	9½— 10	9½— 10	9⅝	..
200,000	Do. do. 4 % Mort. Deb.	Stock	..	..	..	99 —102	99 —102	..	..
35,000	Henley's (W. T.) Telegraph Works, Ord.	5	20 %	20 %	20 %	14 — 15	14 — 15	14½	..
35,000	Do. do. 4½ % Pref.	5	4½%	..	..	5 — 5⅛	5 — 5⅛	..	..
48,050	Do. do. 4½ Mort. Deb. Stock	Stock	..	..	..	108 —112	108 —112	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works	10	10 %	10 %	..	18½— 19½	18½— 19½	18½	..
800,000£	Do. do. do. 4 % 1st Mort. Deb.	100	..	..	..	100 —103	100 —103	..	..
87,500	†Liverpool Overhead Railway, Ord.	10	3½%	1½%	1½%	5⅛— 5⅜	5⅛— 5⅜	..	..
10,000	† Do. do. Pref. £10 paid	10	..	..	..	10½— 10⅝xd	10½— 11	..	..
37,350	Telegraph Construction and Maintenance.	12	17½%	20 %	20 %	33 — 36	34 — 37	..	..
150,000£	Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909	100	..	..	..	100 —103	100 —103	..	..
540,000£	Waterloo & City Railway, Ord. Stock	100	3 %	3 %	3½%	95 — 98 xd	95— 98	97	..

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ From Manchester Share List.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

National Electric Free Wiring, ⅜—⅝.

Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 14¼—14⅞.
Do. do. Pref. (£10 pd.), 10—10⅛.

Bank rate of discount 3 per cent. (June 18th, 1903).

SHARE LIST OF ELECTRICAL COMPANIES (*continued*).—ELECTRICITY SUPPLY COMPANIES.

Present issue.	NAME.	Stock or Share.	Dividends for the last three years. 1900.	1901.	1902.	Closing Quotations Aug. 19th.	Closing Quotations Aug. 26th.	Business done week ended Aug. 26th, 1903. Highest.	Lowest
		‡				⅝ — ⅞	⅝ — ⅞		
100,000	Blackheath and Greenwich Dist. Electric Light, Ord.	1	..	..	..	118 —121	118 —121	..	..
100,000	Do. 4½% 1st Deb. Stock, Prov. Certs.	100	..	..	..	..	..	..	..
20,000	Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000	5	6 %	8 %	8 %	10½— 11 xd	10½— 11	..	..
20,000	Do. do. 7 % Cum. Pref.	5	..	..	..	10¾— 10⅞xd	10¾— 10⅞	..	..
50,000	Charing Cross and Strand Electricity Supply	5	9 %	10 %	10 %	9 — 9⅛	9 — 9⅛	9⅛	9 1/16
70,000	Do. do. do. 4½% Cum. Pref.	5	..	..	..	5⅛— 6 xd	5⅛— 6	5⅛	..
40,000	Do. do. "City Undertaking" 4½% Cum. Pref.	5	..	..	..	4⅞— 5	4⅞— 5	4⅞	..
250,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	104 —106	104 —106	..	..
44,436	*Chelsea Electricity Supply, Ord.	5	5½%	4 %	4⅓%	5⅜— 6⅛	5⅜— 6⅛	5⅞	..
150,000‡	Do. do. % Deb. Stock Red.	Stock	..	..	..	108 —111	108 —111	..	..
70,595	City of London Electric Lighting, Ord. 40,001—110,595	10	0 %	5 %	5 %	10⅞— 11⅛	10⅞— 11⅛	..	..
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	..	..	13 — 14	13 — 14	13½	..
400,000‡	Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid	..	..	..	..	122 —127	122 —127	125	..
800,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	100	..	..	..	102 —105	102 —105	..	..
40,000	County of London & Brush Prov. Electric Lighting, Ord. 1—40,000	10	4 %	4 %	4 %	8 — 9	8 — 9	8 3/16	..
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	..	..	..	11½— 12½	11½— 12½	12¼	12 1/16
400,000‡	Do. do. 4½% Deb. Stock, Prov. Certs. (all paid) Red	..	..	..	..	109 —112	109 —112	109¾	..
50,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	7 %	6½— 7	6½— 7	6 15/16	6⅞
30,000	Do. do. 6 % Cum. Pref.	..	..	..	..	6 — 6½	6 — 6½	6⅜	..
140,000	Do. do. 4½% 1st Mort. Deb. Stock	100	..	..	..	107 —110	107 —110	..	..
21,000	Kensington and Knightsbridge Electric, Ord.	5	12 %	10 %	10 %	10½— 11½	10½— 11½	..	..
90,000	Do. do. do. 4 % Debenture Stock	Stock	..	..	..	103 —106	103 —106	..	..
110,000	London Electric Supply Corporation, Limited, Ord.	3	..	..	..	2 — 2⅛	2 — 2⅛	..	..
49,840	Do. do. do. 6 % Pref.	5	..	..	..	5⅜— 6	5⅜— 6	5 11/16	..
250,000‡	Do. do. do. 4 % 1st Mort. Deb. Stock Red	Stock	..	..	..	100 —102	100 —102	..	..
100,000	Metropolitan Electric Supply, 1 to 100,000	10	6 %	6⅔%	7⅓%	17 — 18 xd	17 — 18	18	17⅞
220,000‡	Do. do. 4½% 1st Mort. Deb. Stock	..	..	..	..	108 —112	108 —112	..	..
250,000‡	Do. do. 3½% Mort. Deb. Stock Red	Stock	..	..	..	97 —100	97 —100	..	..
10,852	Notting Hill Electric Lighting	10	7 %	6 %	6 %	13 — 14	13 — 14	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14⅓%	14⅓%	14⅓%	15⅜— 16⅛	15⅜— 16⅛	..	..
20,000	Do. do. do. 7 % Pref. 20,081 to 40,080	5	..	..	..	8 — 9	8 — 9	..	..
150,000‡	Do. do. do. 3½% Deb. Stock Red	100	..	..	..	98 —101	98 —101	98¾	..
12,000	Smithfield Markets Electric Supply, Ord.	5	..	..	2½%	3⅛— 3⅜	3⅛— 3⅜	3 7/8	3¼
65,000	South London Electricity Supply, Ord.	5	..	..	1⅔%	3⅞— 4¼	3⅞— 4¼	..	..
30,000	Urban Electric Supply, Ord.	5	..	..	..	5 — 5⅛	5 — 5⅛	..	..
30,000	Do. do. 5 % Cum. Pref.	5	..	..	..	5 — 5⅛	5 — 5⅛	..	..
110,000	Westminster Electric Supply, Ord.	5	10½%	10½%	12 %	12½— 13½	13 — 14	13½	13 5/8
28,141	Do. do. 5 % Cum. Pref.	5	..	..	..	6 — 6½	6 — 6½	6⅜	..

* Subject to Founders Shares. ‡ Unless otherwise stated all shares are fully paid.

MARKET QUOTATIONS, Wednesday, August 26th.

CHEMICALS, &c.

		Latest Price.	Week's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a ,, Nitric	per cwt.	22/-	..
a ,, Oxalic	per cwt.	32/-	..
a ,, Sulphuric	per cwt.	5/6	..
a Ammoniac, Sal	per cwt.	42/-	..
a Ammonia, Muriate (crystal)	per ton	£33 10	..
a ,, ,,	per ton	£30	..
a Bleaching powder	per ton	£4 10	..
a Bisulphide of Carbon	per ton	£15	..
a Borax	per ton	£13	..
a Benzole (90 %)	per gal.	7/-	..
a ,, (50/90 %)	per gal.	5/6	..
a Copper Sulphate	per ton	£20	£1 inc.
a Lead, Nitrate	per ton	£24	..
a ,, White Sugar	per ton	£31	..
a ,, Peroxide	per ton	£27 10	..
a Methylated Spirit	per gal.	2/6	..
a Naphtha, Solvent (90% at 160° C).	per gal.	5/6	..
a Potash, Bichromate, in casks	per lb.	3d.	..
a ,, Caustic (75/80%)	per ton	£24	..
a ,, Bisulphate	per ton	£35	..
a Shellac	per cwt.	157/-	3/- dec.
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers	per ton	£9	55/- inc.
a ,, Recovered	per ton	£5 10	..
a ,, Lump	per ton	£5	..
a Soda, Caustic (white 70 %)	per ton	£10 15	..
a ,, Crystals	per ton	£3	..
a ,, Bichromate, casks	per lb.	2½d.	..

METALS, &c.

b Aluminium Ingots, in ton lots	per ton	£130	..
b ,, Wire, in ton lots	per ton	£168	..
b ,, Sheet, in ton lots	per ton	£166	..
p Babbitt's metal ingots	per ton	£43 to £145	..
e Brass (rolled metal 2" to 12") basis	per lb.	7d.	..
e ,, Tube (brazed)	per lb.	8¾d	..
e ,, ,, (solid drawn)	per lb.	7¾d.	..
e ,, Wire, basis	per lb.	7½d.	..
e Copper Tubes (brazed)	per lb.	9¼d.	..
e ,, ,, (solid drawn)	per lb.	9½d.	..
g Copper Bars (best selected	per ton	£71	..

METALS, &c. (*continued*).

		Latest Price.	Week's Inc. or Dec.
g Copper Sheet	per ton	£71	..
g ,, Rod	per ton	£71	..
e ,, (Electrolytic) Bars	per ton	£66	..
e ,, ,, Sheets	per ton	£76	..
e ,, ,, Rod	per ton	£68	..
e ,, ,, H.C. Wire	per lb.	8d.	..
f Ebonite Rod	per lb.	3 3	..
f ,, Sheet	per lb.	3/-	..
n German Silver Wire	per lb.	1/6	..
h Gutta-percha fine	per lb.	8/-	..
h India-rubber, Para fine	per lb.	4 0½ to 4 2½	1½d. inc.
i Iron, Charcoal Sheets	per ton	£18	..
i ,, Pig (Cleveland warrants)	per ton	46/10	1d. inc.
i ,, Forgings, according to size	per ton	From £11	..
i ,, Scrap, heavy	per ton	47/6 to 50/-	..
i ,, Wire, galvanised No. 8	per ton	£9 15	..
g Lead, English Ingot	per ton	£11 7 6 to £11 10	2/6 to 5/- dec.
g ,, ,, Sheet	per ton	£13	25/- inc.
m Manganin Wire No. 28	per lb.	8/-	..
g Mercury	per bot.	£8 10	..
d Mica (in original cases) small	per lb.	4d. to 1/6	..
d ,, ,, ,, medium	per lb.	2/6 to 3/9	..
d ,, ,, ,, large	per lb.	4/- to 7/9	..
p Phosphor Bronze, plain castings	per lb.	1/- to 1/2½	..
p ,, rolled bars & rods	per lb.	1/1 to 1/4	..
p ,, ,, strip & sheet	per lb.	From 1/2	..
o Platinum	per oz.	£4	..
p Silicium Bronze Wire	per lb.	10d. to 1/-	..
i Steel, Magnet, ace'd'g to desc'p'n	per ton	£58	..
i ,, ,, in bars		£15 to £40	..
g Tin, Block	per ton	£127 10 to £128 10	10/- dec.
g ,, Foil	per lb.	1/6	2d. dec.
n ,, Wire, Nos. 1 to 16	per lb.	1/7	..
p White Anti-friction Metals— "White Ant" brand	per ton	£42 to £65	..
j Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	8d.	¾d. inc.
j ,, 6 lea. Flax	per lb.	5¾d.	..
j ,, 3 ply 10 lbs. Russian	per lb.	4 5/8d.	..
j ,, 10 lbs. Russian, single	per lb.	4½d.	..
j ,, 180 lbs. Jute rove	per ton	£11	..
k Zinc, Sh't (Vieille Montagne bnd.)	per ton	£23 15	..

Quotations supplied by Messrs.:—a G. Boor & Co.; b The British Aluminium Co., Ltd.; c Thos. Bolton & Sons., Ltd.; d F. Wiggins & Sons.; e Frederick Smith & Co.; f India-Rubber, G.P. and Teleg. Works Co., Ltd.; g James & Shakespeare; h Edward Hill & Co.; i Bolling & Lowe; j W. H. Hindley & Co.; k Morris Ashby, Ltd.; m W. T. Glover & Co., Ltd.; n P. Ormiston & Sons o Johnson, Matthey & Co., Ltd.; p The Phosphor Bronze Co., Ltd.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RECEIPTS.

	Locality.	Week ending	Receipts for the week. £	£*	Total to date. £	£*	Miles open.	*
	Aberdeen	Aug. 15	1,372	+218	14,442	+ 1,713	10	—
	Birmingham	,, 22	5,140	+431	171,644	+ 8,140	—	—
	Bournemouth	,, 19	1,518	—	—	—	10½	—
	Blackburn	June 26	909	—286	11 668	+ 674	12½	+1½
	Blackpool	Aug. 20	2,104	—431	23,747	+ 895	8½	—
	Blackpool and Fleetwood	,, 22	1,955	+ 43	11,282	+ 721	7½	—
	Bolton	,, 23	2,283	+ 31	40,126	+ 5,581	25	—
	Bradford	,, 23	4,267	+579	81,276	+13,400	41	+4
	Brighton	,, 23	1,131	+ 66	33 986	—	6½	—
	Bristol	,, 21	4,861	—144	—	—	28½	—
	Burnley	,, 22	902	+ 206	—	—	7½	—
B.E.T. Co.	Barnsley District	,, 14	357	—	5,789	—	4½	—
B.E.T. Co.	Devonport	,, 14	491	— 25	14,336	+ 477	5	—
B.E.T. Co.	Dudley—Stourbridge	,, 14	940	+111	26,882	+ 2,849	18½	—
	Gateshead	,, 14	911	+ 75	27,801	+ 4 423	10½	+ ¾
	Gravesend—Northfleet	,, 14	282	+ 53	7,520	+ 240	3½	—
	Greenock—Pt. Glasgow	,, 14	595	—113	17,358	+ 1,388	7½	—
	Hartlepool	,, 14	847	— 36	8,660	+ 445	6½	+2
	Kidderminster	,, 14	148	— 2	4,251	+ 230	4½	—
	Merthyr	,, 14	413	— 5	6,386	— 223	8	—
	Middleton	,, 14	409	+ 73	10, 98	+ 1,229	8½	—
	Oldham—Ashton	,, 14	738	+110	18,591	+ 1,633	8	—
	Peterborough	,, 14	191	—	4,664	—	—	—
	Poole	,, 14	422	+ 33	9,497	+ 1,489	3½	—
	Potteries	,, 14	1,333	— 57	50,084	+ 2,785	28½	—
	Rothesay	,, 14	348	+ 38	4,855	+ 1,611	2½	—
	Sheerness	,, 12	113	—	1,775	—	2½	—
	Southport	,, 14	490	+ 67	9,964	+ 1,944	5½	—
	South Staffordshire	Aug. 14	918	+100	28,184	+ 3,058	21½	—½
	Swansea	,, 14	657	+ 10	16,689	+ 1,465	5½	—
	Taunton	,, 14	104	— 8	1,979	— 165	1½	+1½
	Tynemouth	,, 14	495	— 10	10,195	+ 972	3½	—
	Weston-super-Mare	,, 12	375	+ 18	3,625	— 283	2½	+2½
	Wolverhampton Dist	,, 14	381	+107	12 659	+ 6,586	10½	+8
	Wrexham	,, 14	1-6	—	2,814	—	—	—
	Yorks. Woollen Dist.	,, 14	524	—	8,099	—	6	—
	Cardiff	,, 22	2 088	+454	42,088	+13,689	14	—
	Chatham & District Co.	,, 20	643	+120	17,945	+12,280	8·53	—
	Dover	,, 15	289	— 13	7,155	+ 102	3	—
	Dublin	,, 21	5 284	+289	44,580	+ 6,211	46	—
	East Ham	,, 22	760	+ 269	14,578	+ 4,676	5	+ ½
	Glasgow	,, 22	13,683	+1957	159,946	+18,218	65	+10
	Hull	,, 22	1,883	+106	38,412	+ 1,819	11	+ 1
	Ilkeston	,, 19	187	—	—	—	4	—
	Isle of Thanet	,, 22	1,752	—153	22,557	— 524	10½	—
	Leeds	,, 22	5,630	+511	150,108	+ 7,349	41	—
	Liverpool	,, 15	10,183	+ 92	329,211	+11,538	101	+2½
	Manchester	,, 22	11,886	+ 6672	248,366	—	72	—
	Newcastle	,, 15	3,425	—	—	—	17	—
	Portsmouth	,, 24	2,390	—191	—	—	29	—
	Salford	,, 17	3,817	+1250	75,613	+ 23,570	30	—
	Southampton	,, 13	1,270	—	—	—	9	—
	Sunderland	,, 23	1,506	+ 116	27,085	+ 1,208	20	+3
	Central London Railway	,, 22	5,445	— 36	49,936	— 1,645	6	—
	City and S. London Ry.	,, 23	2,252	- 393	19,456	— 2,685	2½	—
	Dublin and Lucan Elwy.	,, 23	139	— 33	1,168	+ 58	6½	—
	Liverpool Overhead Ry.	,, 23	1,716	+ 46	13,894	+ 756	6½	—

British Elec. Trac. Co.

* Compared with the corresponding period of 1902.

NEW TRANSFORMER INSTRUMENTS.

We illustrate below a new line of transformer instruments for use on high pressure circuits. These are made by Messrs. Nalder Bros. & Thompson, Ltd., 34, Queen Street, E.C., and contain some points of novelty.

In the design of high pressure switchboards, it is, of course, a point of some importance that the instruments themselves should in no way be connected to the high pressure side of the system, so that there can be no danger of shock to the switchboard attendants. The instrument illustrated below is of the iron case type, with nickelled front, fitted with an air-damping device, which makes it perfectly dead-beat.

Instruments of this type are used either as voltmeters or ammeters, through transformers. The design of these transformers

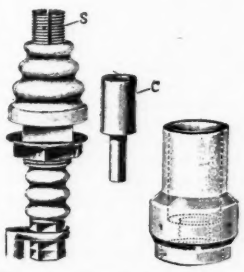


Fig. 1.—Insulator, Socket and Cap.

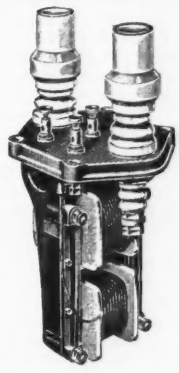


Fig. 2.—Transformer Removed from Case.

has received great attention, both with regard to providing the requisite insulation, and also for convenience in connecting up.

The high pressure terminals are so arranged that the cable can be sweated straight into the socket, c (see fig. 1), which is inserted into a split screw, s, in the top of the insulator; the whole is covered by a porcelain cap, into which is cemented a nut, which can be screwed up, thus clamping the cable socket immediately on to the transformer terminal. This porcelain cap completely covers the socket and the part of the cable which is sweated into it, so that there is absolutely no danger from shock in handling the transformer.

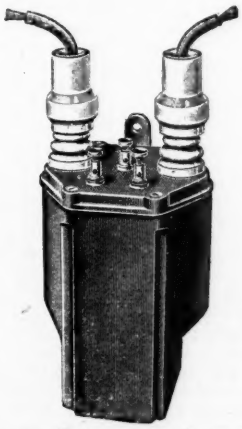


Fig. 3.—Transformer Complete.

These transformers are contained in iron boxes, which are filled with oil, and are suitable for pressures up to 10,000 volts; they are small and compact, and are fitted with lugs, so that they can be easily screwed to the back of the switchboard, or to any other suitable support. The transformers are so designed as to give a constant ratio under all conditions. The apparatus, as a whole, appears to have been well arranged to meet the requirements, and has already been adopted in some British power stations.

ELECTRO-CHEMICAL DISCOVERIES.*

The group of industrial establishments that have grown up around Niagara in the past few years to delve deeper into the mysteries of electro-chemistry, are rapidly transforming many lines of business and trade manufacturing. The supply of electric power in large units has primarily been responsible for this marvellous growth; but purely experimental companies are now carrying on exhaustive tests and experiments to develop new industries for the benefit of mankind, and their work is receiving critical attention from all parts of the world.

Industrial electro-chemistry and electro-metallurgy have already accomplished wonders in the field of manufacture. Carborundum has become a staple product of the electric furnace, displacing in many trades nearly all other abrasive materials. In the past year it has become an important factor in the steel trade, and some 75 tons per month are demanded for this industry alone. More recently tungsten and ferro-tungsten have been satisfactorily produced in the electric furnace, and the use of these in the steel trade for manufacturing self-hardening and high-speed tools has steadily increased.

The manufacture of aluminium, zinc, and manganese in the electric furnace has also achieved considerable importance, and promises for the near future, far-reaching developments. There are several factories now engaged in manufacturing aluminium at Niagara Falls and Massena, and their total output is considerable. Commercial phosphorus is satisfactorily made by mixing the finely-powdered phosphate material with carbon and sand, in the electric furnace, and then, when heated, distilling the phosphorus from the mass, and collecting it under water.

The development of the carborundum industry led to the manufacture of artificial graphite, which is now produced by passing the amorphous carbon through the electric furnace, and obtaining a pure graphite with merely a fraction of 1 per cent. of ash. Even the direct graphitisation of anthracite coals has been successfully accomplished, a granular graphite being obtained which can be extensively used for lubricating purposes. This graphite is easily manipulated with machine tools, and is of great service in many trades. In 1901 over 2,000,000 lbs. of this graphite, were made in this country, and much more in the year just closed.

The electrolytic production of caustic alkalies and chlorine has proved of the greatest importance to the world of trade. The chlorine produced is used for making bleaching powders, which in turn has revolutionised the bleaching trade here and abroad. The production of sodium by electrolysing fused caustic soda has developed rapidly at Niagara and other places where large electric units are supplied at low rates. The production of sodium is now conducted on a large scale.

The application of the electric furnace to steel manufacturing has also received a good deal of attention in France and by the Niagara people. Experiments have been conducted to manufacture steel from pig iron in the electric furnace, and also to smelt the ores directly and manufacture and refine the material in two connected furnaces. At St. Etienne, France, iron ore has been treated most successfully in specially-prepared electrice furnaces, and new factories are being projected for carrying the work forward on a commercial scale.

The manufacture of carbon bisulphide by directly treating in the electric furnace charcoal and sulphur is now in operation at Penn Yan, N.Y., where a daily output of 10,000 lbs. is an average. The electric furnaces employed for this work at the Penn Yan factory represent the largest yet made in any of the electro-chemical industries in this country. They are 16 ft. in diameter and about 40 ft. high, having a capacity sufficient to make a larger daily output than any similar factory in the world.

The production of nitric acid by electro-chemical methods is a new process that promises extensive changes in our agriculture. The manufacture of nitric acid from the nitrogen and oxygen of the air in sufficient quantities for commercial uses has been the dream and hope of scientists for years. At Niagara experiments have been conducted successfully in producing commercial nitric acid by using a high-tension current in an air chamber, by which a yield of 1 lb. of nitric acid is obtained for every seven horse-power-hours. Steps are now being taken to establish the production of nitric acid on a large commercial scale, and while further experiments in this field will be conducted, they will be simultaneous with the practical work of making the product.

So remarkable have these and similar industries become, that purely experimental companies have been formed within the past year to investigate further in electro-chemistry at Niagara for the sole purpose of discovering new processes to patent. They do not intend to establish any commercial factories, but to dispose of the rights to their patents and discoveries to industrial companies which can easily be organised later. They represent the modern wizards of practical chemistry, seeking new discoveries in a field that has already proved exceedingly rich. The experts who compose these experimental companies are searching for definite results along lines already indicated by past successes. Starch, for instance, is receiving considerable attention from the electro-chemists, and it is believed that this will soon be produced by some electric process. Likewise artificial rubber is a substance that is attracting the ambitious, and results already obtained justify the chemists in continuing their experiments with this object in view. The recent scare in prices of good rubber, and the lessening supply of crude rubber, stimulate the workmen to greater effort in the field of electro-chemical experiment.

There are many other lists or groups of products of great commercial value which the experimenters are trying hard to produce artificially by chemical reactions with the high temperature electric furnace. Ammonia, cyanides and silicides are among the most promising of these, although not by any means the only ones. The manufacture of artificial camphor is now assured, and calcium carbide is now produced on an enormous scale. One company converts barium sulphate into other needed barium salts. Barium hydrate is now produced so successfully that its price enables the different trades to use it in many minor ways. Both the sugar and paint trade—two widely distinct industries otherwise—employ barium hydrate on a large scale.

One important feature of all these new industries is the stimu-

* *Scientific American.*

lating effect they have upon widely separated trades and manufacturing industries. By producing materials on a large commercial scale, they enable other trades to utilise them in ways never before considered possible. With the cheapening of the products their use becomes universal. They have thus directly tended toward lessening the cost of production of articles in common use. Synthetic electro-chemistry is thus proving in its quiet way one of the greatest trade revolutionising factors the world has ever known. The unlocking of secrets by man's ingenuity is always fascinating and stimulating, but when they in addition help mankind by placing within the means of everybody articles which were formerly considered luxuries, the result is something that holds the admiration of all. From Niagara, Massena, Penn Yan, and other places where large electrical units are easily obtained, the world of science and trade, hope for revelations that more than rival the visionary acts of mythical wizards of old.

INSTITUTION OF ELECTRICAL ENGINEERS.

(Calcutta Section.)

ON THE PRESERVATION OF INSTRUMENTS AND MACHINERY IN BENGAL.

By Paul Brühl, Member.

(*Paper read at Calcutta, March 27th*, 1903.)

(*Continued from page* 318.)

The swinging parts of fine balances, such as are used in electrolytic-analytic work, should be platinised, as should also be accurate sets of brass weights. Some of the best things in this line are obtainable from Bunge, in Hamburg. Ordinary sets of weights should be strongly nickelled. I have found gilding much less efficacious than platinising. The reason is probably that gold is not only softer than platinum and becomes rubbed off or scratched more easily, but the coating of gold is often decidedly porous; the slightest want of continuity in the gilding leads to a rapid formation of verdigris, and the gilt weight is then worse off than the ungilt one. Any steel parts of the swinging system of a balance are sure to be a source of trouble; I cover them with a very thin film of spindle oil, but I prefer the steel to be replaced by phosphor bronze. Steel knife-edges are useless except in coarse balances; balances used in electrolytic work should invariably have their knife-edges and bearing surfaces of agate.

Aluminium, provided it is pure, appears to stand the tropical climate tolerably well; some aluminium, however, becomes quickly converted into hydroxide, and on the whole I do not advise the use of aluminium for parts of instruments; of course where special lightness is required, the use of aluminium may be unavoidable. There is little trouble with German silver and platinoid. Stretched iridium-silver wire, as sometimes used in meter bridges, invariably snaps. Bare manganin is not quite climate-proof and requires careful watching. A peculiar change takes place in the suspension strips of the D'Arsonval galvanometers of some makers. After a short time one finds the resistance of the galvanometer to increase rapidly, until it nearly reaches infinity. On examination one finds the strip converted into an exceedingly fragile thread of oxidation products.

Another marked source of trouble are galvanometer mirrors. I have repeatedly received galvanometers with the silvering of their mirrors either cracked all over and portions of it flaked off or rendered useless by tarnishing. Clark Fisher makes the remark that English-made mirrors, although much cheaper than French ones, are much inferior to the latter. My own experience is entirely in the same direction. Personally, I have had little trouble with mirrors obtained Hartmann & Braun in Bockenheim-Frankfort-on-the-Main and from Siemens & Halske in Berlin. It is, however, always the safest plan to have a few spare galvanometer mirrors in stock. As the best temperatures for silvering such mirrors lie about 20° C., the temperatures ruling in India are usually too high for an attempt to re-silver one's mirrors oneself to prove an unqualified success.

Great care should be bestowed by manufacturing firms on soldered joints, especially joints in standardised resistance wires. A potentiometer volt-box caused me once a great deal of annoyance in this respect. You will know that such a volt-box as made by certain makers consists of many turns of fine manganin wire wrapped round thin glass cylinders, the total resistance being 50,000 ohms. Even before the volt-box had come to be used, the majority of the soldered joints had given way, unfortunately one of them hidden away underneath another layer of wire. All the joints showed clear evidences of chemical corrosion, although the room in which the box was kept was absolutely free from chemical fumes. The soldered joints of suspended coil galvanometers meet frequently the same fate.

One of the most powerful corroding agents employed by nature is carbonic acid. We are accustomed to look at carbonic acid as a weak acid; at least that is what elementary books on chemistry tell us. Of course, it is weaker than various other acids; but in many instances it is weak only because it is volatile—volatility is not usually compatible with strength—or it is weak because in an aqueous solution prepared under atmospheric pressure it is exceedingly dilute. But when the acid is more concentrated under the action of high pressures, the effect is markedly different. Now capillary action has a similar effect on concentration as a large increase of superincumbent pressure; and the carbonic acid present in the film of moisture which covers all articles during the rainy season, or in the film separating two surfaces in apparent contact, is in a much more concentrated state than corresponds to the atmospheric pressure. Such carbonic acid is capable of displacing the silicic acid of natural and artificial silicates. Here it is that the mischief comes in. Hence the crusts of sodium and potassium carbonates found plentifully in nallahs of Chota, Nagpur and Behar during the dry seasons; hence the dimming of surfaces of glass slides in contact with each other; hence the film which ruins lenses kept in confined situations. As electrical engineers often have to use reading telescopes and microscopes, and as probably many of them practise photography, a few words on the action of carbonic acid on glass may not be out of place here. Microscopists know how difficult it is to keep a stock of blank glass slides. If you keep your glass slides in contact with each other, they are sure to grow dim after an astonishingly short period of time, sometimes even if placed in alcohol. An absolutely safe plan is to tie two threads round each separate slide near its two ends, form a number of slides into bundles and keep them in alcohol or formalene. Every chemist in the country has noticed how flasks kept for some time without being used either develop a moss-like growth of sodium carbonate or have their inner surface throwing off one film after another, until the flasks are sometimes filled with these onion-coats of mica-like films. If glass vessels are in constant use or are kept filled with water or very dilute sulphuric acid, their inner surface remains bright and clear. The worst place in which to keep microscopic objectives during the rainy season is the cylindrical brass case provided for them by the makers. Microscope lenses, in fact, lenses and glass parts in general, do not stand close confinement for any length of time. Constant use is the best preservative. In any case place the lenses in a capacious box and air them frequently. Although makers usually deprecate people opening out systems of lenses, in this country this is the only means of preserving lenses from the attacks of carbonic acid. I unscrew the parts of objectives at regular intervals of time and wipe every single lens carefully with a soft piece of cotton cloth; I do not recommend the use of silk handkerchiefs for the purpose; they are not absorbent enough, and one has to rub the lenses longer than if one uses well-washed cotton cloth. Some of the modern kinds of glass have to be tended very carefully; otherwise they will soon begin to exhibit mould-like growths of carbonates or become dim evenly all over their surface. The appearance of such growths means ruin to the lens.

A chemical change of considerable importance to people having to do electrical testing is the oxidation of the sulphur in ebonite with the consequent formation of sulphuric acid. This change proceeds with considerable rapidity especially during the rainy season. Apparatus which are constantly in use, and which, therefore, are frequently wiped down, suffer comparatively little. If, however, the insulation of ebonite parts should be found to have broken down, it is best to moisten them with some dilute caustic potash solution, wash them with plenty of hot distilled water and rub them dry with a clean cloth. Having mentioned ebonite, I am reminded of india-rubber tubing and rubber stoppers. It is astonishing how rapidly they deteriorate in this country. The best way of keeping rubber stoppers is to put them into a wide stoppered glass jar, at the bottom of which is placed an inverted perforated dish to serve as a support for the stoppers, after pouring some oil of turpentine on the bottom of the jar. Stoppers which have acquired a hard cracked surface can be softened by proceeding similarly, only using chloroform instead of turpentine. A good way of preserving rubber tubing is to give it a coating of glycerine. Gutta-percha bottles, such as are used for storing hydrofluoric acid, are best protected by covering them all over with paper gummed on.

One of our greatest chemical enemies in this country is nitre; but as I am engaged in a detailed study of this subject, I prefer to leave it alone for the present, and at the same time I pass on to the last part of my subject: Biological Influences.

I shall not take up your time by dealing in detail with the omnipresent microbe; with the microbe of infectious diseases, which by attacking either ourselves or our assistants and workmen causes interruption and delay in our work; with the nitre-producing microbe which covers our walls and instrument-pillars with destructive inflorescences. Neither shall I occupy myself with the fever-amœba which causes more havoc and financial loss than many a more quickly acting bacterium; its effect on instruments and machines is only indirect, although sometimes patent enough. More direct is the action of mould. I have often observed beautiful specimens of mucor growing on ivory parts of apparatus, for instance, on ivory pins and eyelets used for insulation. It is chiefly new apparatus which is thus affected, just as it is the new binding of books which suffers most acutely from the attacks of mould. But as only certain constituents of the ivory or the binding of books supply foodstuffs to the growing mould, the latter disappears as soon as those nourishing materials are exhausted. Free circulation of air and plenty of light are probably the most powerful preventatives of mould growth.

Besides fungi, there is no other member of the vegetable kingdom which acts injuriously on apparatus. It is very different with the animal kingdom. The world of invertebrates supplies spiders and cockroaches, and flies, and white ants, and boring beetles, and various hymenoptera. One could write up quite a formidable charge-sheet with the cockroach and the white ant as accused. One remark concerning white ants is of interest. I have rarely found white ants attacking books on shelves not quite close to the walls and floor, provided the books stand on end, and are not too tightly placed against each other. Of all my enemies, I detest the cockroach most. Of course, killing them is the most effective way of getting rid of them; but then you have to catch them first.

Fortunately, there are some means of interfering with their pleasures of life, for they love darkness and damp surroundings. I avoid, as much as possible, boarded-in cupboards, and keep my apparatus in almirah tables, the doors and sides of which are glazed, whilst all the wood parts inside are painted white. A plentiful supply of naphthalene completes the means of defence. White ants, like other members of the insect world, dislike kerosene oil; but they are best battled against by constant watchfulness. An occasional joke is perpetrated by wasps, who like to build their mud nests into any available hole, in ceiling roses, stop-cocks, inlet holes of electric wires. Much more disagreeable are flies, who love to settle down in hundreds on the flexibles of pendant incandescent electric lamps, and who, by covering the flexibles with their excreta, lead to the formation of short-circuits. Spiders and their webs are, in one sense, rather useful; they serve as indicators of negligence of the staff who are responsible for the cleanliness of the place.

Among the vertebrates are various members of the order of rodents. And very destructive they are. They carry on their mining operations in the foundations of machines, make use of woodwork to sharpen their teeth on, and do all sorts of other mischief. One of the wretches got once into an almirah where I kept a box containing quartz fibres; there were not many of those fibres left in a serviceable condition. It is advisable to keep the instrument almirahs well off the wall and have their bottom board about 4 in. clear of the floor.

We finally arrive at the crowning piece of animal creation, man—man especially in the guise of a coolie, a bearer, a mistry, an overseer.

The two things one has constantly to contend with when in charge of a laboratory or an engine house are dust and grit in the dry seasons and dampness during the rains; and it is here where the laboratory bearer and the engine house cooly-attendant come in. Unfortunately most natives of this part of the world have no eyes for dust and cobwebs. A sixteenth of an inch of dust on every article of furniture or apparatus, and a splendid array of hangings, the products of the ceaseless activity of our friend the spider, leave the average native in an absolutely happy frame of mind. Personally, I have spent quite an appreciable part of my life in the exploration for cobwebs and in drawing my fingers across the dust accumulated on laboratory furniture and apparatus; of course, these operations are usually accompanied by candid expressions of my opinion on the subject; but still it takes one years before one succeeds in training a few even of one's bearer assistants in the ways of cleanliness, and then there is every chance of them getting an attack of fever and clearing out to their "country," as soon as they are getting into European ways of cleanliness and tidiness.

Another peculiarity of the common Indian workman is that he wants to carry everything on his shoulder or on his head. Give him an instrument case provided with a nicely nickelled handle, and as sure as anything he will snub the handle and swing the box on his shoulder top downwards. Sense and forethought you must not expect of him. If you meet a low-caste Indian who has sense of his own, thank all the Indian Pantheon for it and consider him your brother. But you must remember every detail for him. "I have forgotten it" seems to his mind an all-sufficient excuse for any sin of omission. I may be permitted to suggest here a subject for a paper which would be very interesting to many of us; a paper on "The Indian Workman: his Idiosyncrasies and his Management."

Having had to refer to dust and dirt, I do not think people out here are always as careful as they might be in protecting their machinery from the deteriorating influence of grit and dust. One sometimes finds even in Europe-bred Europeans a tendency to fall in with the views and habits of the natives. Of course, as regards dust, it matters little where a carpenter's bench or a blacksmith's forge is placed; an open shed with a dust-generating mud-floor is about as good as anything for ordinary work. But it does make a difference whether first-class machinery, especially dynamo-electric machinery, but also finer lathes and milling machines, are plumped down on a gritty mud-floor or in a cobwebby dark, damp corner, or whether the machines are placed in a well-lighted machine room provided with a proper brick-on-edge or patent stone floor. It is true a "pakka" floor costs money; but the ruining of good machinery by grit is not exactly a cheap operation either. There is another superstition alive in the minds of some people, and that is, that a dark corner is necessarily a cool corner. This is by no means the case; 85° F. in a dark, damp room is often less bearable than 95° F. in a well-aired, well-lighted room. It is quite true that the Indian coolie is accustomed to dirty surroundings, and although hardly thriving on dust and dirt, the coolie feels quite happy in it. But even he is not accustomed to a life in dark, confined rooms. A great part of the Indian's life is really spent in the open air and in the sunlight, and he will do his work all the better and the more cheerfully if you give him plenty of air and light in your workshops. Probably the best position in Bengal for an engine and machine room is to have its length in a north-south direction. It should have large venetianed doors in the south and north walls, plain walls on the east and west sides, and in these walls a row of large round or square windows higher up near the ceilings. This arrangement provides a good through-draught and plenty of light.

In this connection I may allude to the subject of paint and varnish. Of course, anything gaudy looks unworkmanlike; sober tints like chocolate-brown or olive-green suit an engine room best; but it pays well to spend some trouble and money on one's engine room. Just place the same native in charge of two precisely similar machines as far as the finish of the working parts is concerned, but leave one in the rough state and paint the other, so that the latter presents a pleasing appearance, and then watch how the coolie-attendant treats the two machines. He will treat them exactly according to their looks.

Finally, let me say a few words about our friend the mistry. A good mistry is an estimable and very useful member of society, trustworthy on the whole, although requiring the guidance of a superior to prevent his energies from flagging and his activity from being directed into wrong channels. As long as he moves along well-trodden paths he is safe; he becomes dangerous only when he begins to theorise, when he acts on self-conceived hypotheses, when he follows out new lines of thought. Let me conclude my lecture by relating one or two incidents.

You will remember that the original Brush lamp had a cut-out arrangement which included a hinged soft-iron armature; if I am not mistaken, it was precisely this cut-out which made the good old Brush lamp a commercial success. An intelligent mistry once had charge of about a dozen of these lamps, and he evidently had been puzzling his brain over this cut-out arrangement. The outcome of his investigations was that the cut-out served no useful purpose whatever, and the uselessness of the arrangement grated on his sense of the fitness of things. Nature causes the gradual disappearance of parts which fulfil no useful purpose; the mistry went further; he wrenched off the cut-out arrangement in all the 12 lamps. It did him no harm, but he did not see the good of it.

Worse was the fate of a Lord Kelvin's electrostatic voltmeter. The native mistry in charge of a certain installation had, guided by some unaccountable theory of his own, come to the conclusion that the connections at the back of the switchboard—they had been made under the personal supervision of a European electrical engineer—were wrong. So he altered the connections, and in doing so he disconnected a pilot wire which was connected up to one terminal of the voltmeter. Of course, the voltmeter ceased to indicate, and the mistry jumped to the conclusion that the voltmeter had gone wrong. So he opened it out, and in doing so, broke the suspension. But he was quite up to the occasion, and replaced the elastic strip by a bunch of No. 40 copper wire abstracted from a flexible. You may imagine the result.

But all this is good-natured mischief. The moral status of the man plays no part in it. It is different with the manufacturer at home who thinks that anything is good enough for India; it is a different matter with the native who puts a nut between the armature and the pole-piece of a dynamo to get another native, whose place he covets, into trouble. There is no absolute protection against this latter kind of evil influences.

And herewith let me say good-bye to the whole crowd of agents, mechanical, physical, chemical, and biological, who affect our happiness in this hot and moist country.

Discussion.

Mr. C. T. Williams observed that the paraffin wax used in the manufacture of instruments at home, appeared to be softer than that imported into India for use in the country. This was specially prepared to resist high temperatures and, as a rule, no difficulty was experienced with regard to this wax oozing out of instruments, although this was sometimes the case with English-made instruments. It had been found possible to harden wax by melting up resin with it. For preventing rust this speaker found that Rangoon oil (the imported, not the local article) was excellent, and that a satisfactory way of storing bright steel parts of instruments in damp climates was to wrap them in paper soaked in Rangoon oil. The Indian Telegraph Department had not hitherto manufactured resistance coils with manganin wire, but this was about to be tried. He was interested in learning that this metal was, in a slight degree, liable to rust, but as the wire would be double silk covered and soaked in paraffin, there would be no reason to apprehend that it would be in any way injured. This speaker drew attention to the very bad work put inside induction coils by some makers at home. It was no uncommon thing to find a coil fail owing to soldered joints being corroded through, this being due to the fact that resin had not been used for a flux. The connection to the condenser was also very faulty. This sometimes consisted of a piece of wire pressing on the tin foil, and kept in place by a piece of board. The board warps and the connection fails. He asked for further information as to the preservation of lenses, and stated that he found what was known as cheese cloth to be very useful for cleaning them. The great enemies of india-rubber he found to be light and dry heat. Rubber appeared to keep well in dark damp places. He had noticed that recently makers had discontinued polishing ebonite on instruments, and this had certainly improved the surface insulation. He had tried using unpolished ebonite on an electroscope, which was required to retain its charge for a long period, and found that it would do so for as long as 24 hours instead of a very short time when polished ebonite was used. There was, however, nothing new in the idea, as it had been used by Prof. Ayrton years ago.

Father Lafont stated that, in his opinion, aluminium was a most unsatisfactory metal for use in that country, owing to its rapid oxidation, and that he would never use it for any instrument wherever. Incidentally also he considered nickelling to be better than silvering.

Mr. Eustace: Owing to my position in Calcutta, I have a great many instruments and machines under my charge, and one of the hardest problems I have to solve is how to preserve them. In our two electric supply stations we have 18 dynamos, and I might almost say a countless number of instruments, all of which require the greatest care in their preservation. The conditions that prevail in a hot moist climate are such, that it appears almost impossible to make the mind of a European manufacturer, dwelling in cooler climes, understand. I think, however, that our cousins across the Atlantic are more open to receive new ideas, and to adapt themselves thereto. The Professor finds, and I think so many of us do also, that his goods are damaged before they reach him, but I do not suppose that it is always possible to so design a sensitive instrument, and despatch it, however carefully packed in its working state, so that

it could be sent by rail in the United States. Manufacturers, however, seem to think differently, and instead of taking a delicate instrument as much as possible to pieces, and packing the pieces separately, they seem to consider it sufficient to stuff the moving parts up with silver paper, and pack the instruments in straw. The consumers' meters sent out for the Calcutta Electric Supply Corporation, although excellently packed in hermetically sealed cases, as often as not arrive with pinions and gear wheels covered with rust. I would suggest that in a case like this, where the rust must be due to sweating inside the case, that all the cases should be well dried with unslaked lime before receiving their contents, and being sealed up. In the other direction, however, that of mechanical injury due to bad packing, I think, lies one of the chief causes of complaint. The Professor is fortunate enough to get the goods packed in wood shavings, but I presume that the cost of these is far greater than straw, hence the adoption of the latter in spite of the fact that all bright parts packed in straw arrive in a thoroughly rusty state, and also of repeated warnings not to do so.

I have *a European* foreman under me, who has lived a great many years in this country without ever having been home. He is a German by birth, but has forgotten his native language, and has not yet learned English, much less Hindustani or Bengali. Perhaps this accounts for his occasional want of thought, as he must have some difficulty in thinking at all, being master of no language. Well this well-meaning and hard-working man was one day attending to a fault on the underground mains, and after he had repaired the broken cable, he pushed a pin through the insulation to see whether the current had again been turned on. Happily a representative of the cable company was present and explained the iniquity to the experimenting foreman. The mistry is a good man at one job, and generally when thoroughly trained can be relied upon. Excellent men can be found to do such delicate work as repairing instruments, and although they are not very fast they do the work well. I do not remember any case of a dynamo being burnt out from heat, pure and simple, without some other cause at the back of it. The springs on some of the meters recently imported have been gilded, and this I find fairly satisfactory, although I have had much trouble with ordinary springs previously. I have had cases where a resistance of manganin [? manganese] steel after withstanding heat for a certain length of time had disintegrated, so that it crumbled in the hand. There is no question as to what is the fundamental difficulty in preserving instruments and machinery in Calcutta, it is the climate, which has often the same effect on men. Temperature is often a great trouble, and during the hot weather, I have known the temperature on the station switchboard to be as high as 112° F., and this with an atmospheric humidity of over 90.

(To be concluded.)

AN OIL ENGINE CENTRAL STATION.*

By HOWARD S. KNOWLTON.

A RADICAL departure from existing central station plants is afforded by the new electric light plant at Jewett City, Conn., a town of about 3,000 inhabitants, located on the Worcester division of the New York, New Haven and Hartford Railroad, some 10 miles from Norwich. The new plant, which was started about the middle of July, has the distinction of being the first central station in this country to adopt the Diesel oil-burning engine as its source of motive power, and represents an interesting example of elimination—no boilers, stacks, coal bins, stokers, economisers, or heaters being necessary. Compactness is the key-note of the whole design. Until the new plant was started, Jewett City was lighted electrically by a 60-KW. Westinghouse 2,200-volt 60-cycle single-phase alternator driven by water-power at the Aspenock Bleachery. The claims made for the Diesel engine, convinced the town authorities that a new station could be operated with profit, and the result represents one of the most advanced types of small lighting plants to be found in the East.

The power station is located on the west bank of the Pachaug River. It is a neat brick building one story high, with a monitor capped roof. The length of the structure is only 37 ft. 8 in., and its width is 30 ft 8 in., while the height from the top of the foundations to the top of the monitor figures up about 26 ft. A small brick chimney about 8 ft. high carries away the products of combustion discharged from the engine cylinders; before entering the chimney, the exhaust gases pass through a muffler. The interior brick walls are painted white, and the station is well provided with windows on all sides.

At present there is but a single room in the plant. The height of the room is 14 ft. from the floor level to the bottom of the horizontal beams of the roof truss. Space has been provided for a small office in the north-west corner of this room. A double door 5 ft wide is built in the west wall to permit the easy ingress or egress of machinery. Probably one corner of the room will be fitted up as a repair shop later on.

The oil supply for the engine is drawn from two storage tanks set underground near the station. Their combined capacity is 6,500 gallons. The oil, which is crude, is brought to the plant in tank wagons holding 640 gallons, and costs 4·6 cents per gallon delivered. It is pumped from the main tanks to a vertical tank holding 40 gallons, and from this tank it is supplied to the engines.

* The *American Electrician.*

The generating plant consists of two 60-KW. Westinghouse single-phase 2,200-volt 60-cycle alternators, belt-driven by two 75-B.H.P. triple-cylinder Diesel oil engines, of the vertical marine type. The engine cylinders are all 15 in. stroke and 10 in. diameter. The I.H.P. of each engine is about 100.

The engines constitute the most interesting feature of the plant and were built for the American Diesel Engine Co., of New York, by the International Power Co., of Providence, R. I. They operate on the well-known Otto cycle of admission, compression, combustion, expansion and exhaust, but differ radically from ordinary gas and

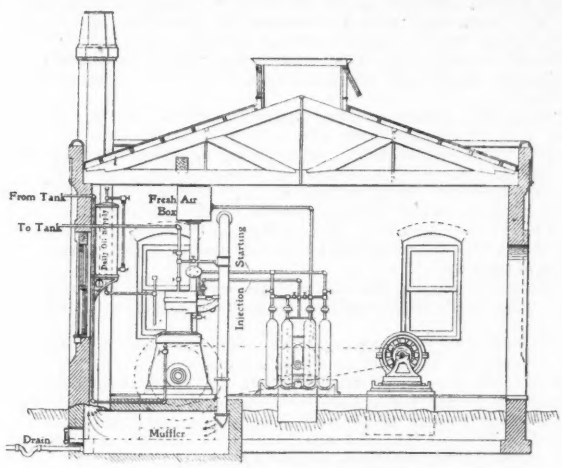


FIG. 1.—TRANSVERSE SECTION OF POWER HOUSE.

oil engines in the character of the combustion. This is not of explosive character, but is steady combustion at high compression temperatures. During the compression stroke the cylinder contains air only, and the temperature due to compression ignites the combustible charge without the need of electric spark or ignition tube apparatus. The clearance is about 7 per cent. of the cylinder volume, and the combustion of the vaporised oil does not increase the pressure caused by the compression. The cylinders are symmetrically mounted on the engine housing and drive a single shaft through cranks having 120° displacement.

The valve operating cams are on the usual secondary shaft driven by the main shaft through an intermediate gear. The admission and exhaust valves are driven by two of these cams. The movement of the admission valve particularly is very slight. The oil is driven into the cylinders by compressed air through a

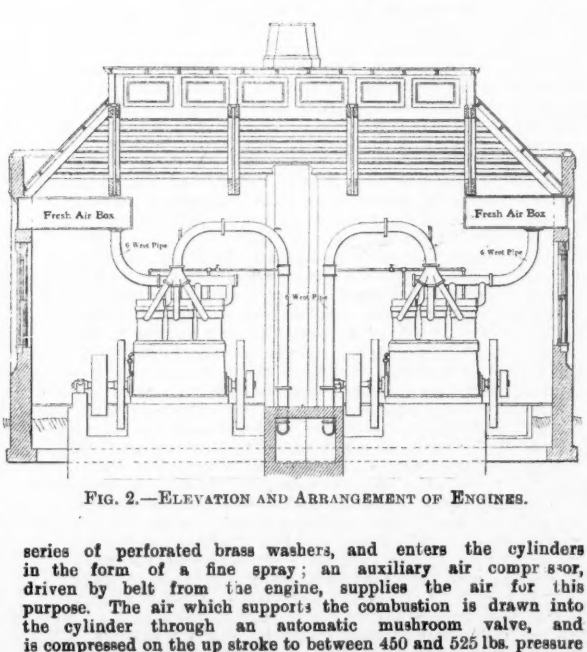


FIG. 2.—ELEVATION AND ARRANGEMENT OF ENGINES.

series of perforated brass washers, and enters the cylinders in the form of a fine spray; an auxiliary air compressor, driven by belt from the engine, supplies the air for this purpose. The air which supports the combustion is drawn into the cylinder through an automatic mushroom valve, and is compressed on the up stroke to between 450 and 525 lbs. pressure per square inch, corresponding to a temperature of about 1,000° Fahr. The fuel valve is open for about one-tenth of the working stroke, and the fuel is let in and consumed during the whole or a part of this period as determined by the action of the governor. At the termination of the fuel supply, the resulting gases of combustion work expansively during the remainder of the stroke. The combustion is singularly complete on account of the large quantity of oxygen in the cylinder at the beginning of the working stroke. Any grade of crude or fuel oil may be employed in the engine.

The fuel oil is delivered to the fuel-admission valve by a pump driven from the cam shaft. One pump cylinder is provided for

each of the main cylinders, and behind each is a by-pass valve, which, when open, allows the oil to flow again to the suction side of the pump instead of to the fuel valves. The length of time that these by-pass valves are open is controlled by the governor, which is of the centrifugal "Begtrup" type. The by-pass valves are opened by three arms pivoted at one end on a shaft which the governor raises or lowers. These arms are operated by connecting rods driven by eccentrics on the pump-driving shaft. By a link connection, the governor collar thus increases or lessens the distance between the top of the by-pass valve rods and the arms which open them. Upon the relative distance between the top of each valve rod and its corresponding arm depends the length of time the valves are open, and the consequent duration of oil supply for combustion purposes.

After the fuel valve closes, the gases work expansively, and the atmospheric and terminal pressures differ but little. The effect of the compressed air used to inject the fuel is inappreciable. The admission valve is open a constant length of time, but the fuel supply is controlled by the governor as just described, so that only at full loads is it injected into the cylinder during the entire period that the valve is open. It has been stated that the thermal efficiency of the Diesel engine runs as high as 38 per cent.

In general outward appearance the engine resembles the ordinary marine type of steam engine. The connecting-rod is carried directly on a pin inside the piston, as usual in single-acting engines. The reciprocating parts are all enclosed within the engine housing, which is fitted with detachable plates for easy access. Lubrication is automatic, a large oil well in the lower part of the housing doing service as a bath into which the connecting-rod crank end plunges at every revolution. Double fly-wheels are provided for each engine in addition to the driving pulley.

The engines are started by compressed air from auxiliary reservoirs, which are filled by the engine-driven compressor already mentioned. The attendant opens a starting valve which admits compressed air to drive the piston for two or three revolutions, after which the compression in the cylinder is sufficient to ignite the charge: the starting cam is thrown out of action automatically as soon as the attendant throws in the admission and exhaust valve mechanism. Enough air is always stored in these reservoirs to enable the plant to start with ease.

In the drawings of the plant reproduced herewith, the auxiliary reservoirs are not shown located exactly as finally installed; but no essential feature has been changed. On the east side of the building, just outside of the engine-room wall, is located a wooden water tank with a capacity of 7,000 gallons. The water from this tank is circulated through the jackets of the engines and is used over and over again. Each engine drives a small pump beneath the floor which replenishes this tank when necessary.

Each of the two alternators is mounted on timbers, and is compound wound, driving its exciter by belt. The exciters are each 1·5 KW. 125 volt machines, and run at 1,300 r.p.m.; these are also mounted on short timbers for insulating purposes. The wiring from machines to the switchboard is carried below the floor level, and all 2,200-volt circuits are run in lead-covered cable.

The switchboard is located on the south side of the generator room, and is composed of two panels of special marbleised slate supported by a steel tubing frame. Rubber mats are placed in front of both machines and switchboard. The board is 8 ft. long and 5 ft. high. Each machine is protected by an Elden circuit-breaker which is modified so as to short-circuit the compounding winding at the rectifier after the exciter circuit has been opened automatically. Each panel contains a machine voltmeter and ammeter in addition to the circuit-breaker, and a double throw, double-pole interlocking switch for connecting the commercial circuits to either alternator. In addition, one panel carries two double-pole single-throw exciter main switches, and a double-pole double-throw horizontal station lighting switch which throws the incandescent lamps, which illuminate the plant, upon either exciter.

One of the panels also contains a double-pole double-throw quick-break switch for connecting the series street lighting incandescent circuit with either alternator. To provide against excessive voltage at the lamps, in case any one of the series incandescents burns out and short-circuits through the base, six lamps have been installed on one of the panels in connection with a radial switch, which throws them in circuit one by one as may become necessary to replace burned-out lights. The street lighting circuit is also provided with an indicating ammeter. Rheostats for the alternator fields are to occupy the lower central portion of one panel of the switchboard.

The station wiring is run in neat parallel lines from the switchboard along the wall to the apertures where the circuits leave the building. At present there are two single-phase commercial circuits supplying house to-house transformers, and one street series circuit made up of 30 C.P. 5·5-ampere incandescent lamps. The total connected load is equivalent to about 2,000 16-C.P. lamps at present. There are no direct-current circuits in the town.

The economy of operation shown by the Diesel engines is of interest. The machines in the new plant are guaranteed to operate on 0·47 lb. of oil per brake horse-power hour at full load, and on 0·5 lb. oil per brake horse-power hour from friction load to full load. With oil at 4·6 cents per gallon, this means about 1 cent per kilowatt-hour, including wages and supplies, the attendance required being very small. The high efficiency of the engines, added to the small relative cost of attendance on account of the simplicity of the apparatus, gives the Jewett City plant every prospect of financial success if it is properly operated. The estimated cost of operating an equivalent steam plant was prohibitive. The present plant is owned by the town, and it is expected that the gross receipts, which last year were about $6,500, will be greatly increased as a result of the reduced cost of the service. The results of operation at Jewett City will undoubtedly be watched with special interest by those who are concerned with the development of lighting and power enterprises in small towns. The plant was installed by H. B. Rust & Co., of Providence, R.I.

THE FIDUCIARY POSITION OF LOCAL AUTHORITIES.

If the representatives of ratepayers upon the local councils thoroughly grasped their position as trustees of public money, and their liability to be surcharged as in the recent case at Romford, they would not resent the proposals of the Select Committee, which are to practically place the responsibility for speculative undertakings upon the ratepayers.

The Committee express a doubt as to whether the extent of the financial burdens consequent upon the powers sought to be obtained, are sufficiently brought home to the knowledge of the ratepayers.

In the case of the promotion of Bills, it is true that under the Borough Funds Act, the consent of the ratepayers is necessary, but everyone knows how imperfectly this is carried out, with the result that the bulk of those interested really know nothing of what is being done.

It is often the case that in what is termed an Omnibus Bill, containing a large number of matters of a most ordinary and routine character, one or two paragraphs are inserted under which trading powers are sought which might involve risks that the majority of ratepayers would object to if their attention were specially called to them.

Of course it will be said that if the ratepayers are vigilant and take a proper interest in the management of their local government affairs, they possess the means of preventing their representatives from rash undertakings, but the procedure is clumsy and imperfect, even in the promotion of Bills, and still more so in the case of provisional orders, which may be applied for without any previous mandate from the ratepayers.

If the local authorities, before taking any action outside their ordinary duties, which involved such trading operations, for example, as the supply of electricity, were compelled to submit the proposal to a poll of the ratepayers, the responsibility would be undertaken by them and their representatives supported in their fiduciary position.

The argument that ratepayers in electing representatives practically give them power to act for them to an unlimited extent, can only fairly apply to routine management upon existing lines of policy.

The Select Committee on Bills promoted by local authorities, as well as the Committee on Municipal Trading, wisely recognise this principle in their respective reports and the irritation apparent in some quarters, which threatens opposition to their recommendation, will be unlikely to assume a very formidable character.

It is satisfactory to find that the drastic proposals for establishing a thorough audit of municipal accounts is already publicly approved by some of the town clerks whose opinions have been solicited by one of our contemporaries, notwithstanding the statement of the journal in question "that the report of the Committee, if carried into effect, would practically rob the local authorities of the financial control of their undertakings."

The clerk of the Merthyr Tydfil U.D.C. thinks the suggested audit admirable, and says that "heaping up loans is a curse to a district and misleading to the ratepayers."

The town clerk of Sheffield almost lost his breath at the drastic character of the Committee's recommendations, but nevertheless admits that "the present system of audit by the elective auditors and the Mayor's auditor is scarcely to be commended; and it is also true that there is a lack of uniformity in the method of audit pursued by different local authorities."

Then, again, the town clerk of Sunderland says that "all will agree as to the desirability of a uniform and complete system," and approves "the recommendation as to the form in which the accounts should be kept as probably the best that could be made."

Such opposition as the foregoing will not produce a very formidable barrier to the adoption of the suggestions of the Committee.

The real objection to the proposals appears to be in the fear that the auditors will "express an opinion upon the necessity for and adequacy of reserve funds, and in respect of depreciation and obsolescence of plant, in addition to statutory sinking funds."

If such duties are undertaken by the auditors, the position of the municipal electricity undertakings will not be recognised by those who have acted on the principle that the statutory sinking fund covers provision for depreciation and reserve for antiquation and contingencies.

We agree to some extent with the town clerk of Sunderland in his preference for certain principles of accountancy being established by positive and general compulsory enactment, but this could only be applied to such matters as provision for depreciation, while items of expenditure fairly belonging to the electrical undertaking, and which, in many municipal accounts, are charged to other departments, would be necessarily left to the auditor's decision.

After such opinions as those expressed in the Committee's report, it is obvious that the distinction made in the Board of Trade form of accounts for municipalities and companies, with reference to depreciation, can no longer be maintained. They dispose of the contention that the sinking fund affects the question; and, indeed, it

is surprising that the idea should ever have been entertained that payment for plant by instalments instead of cash down, could cover anything beyond the items which were represented by the loan. The limited reserve fund against contingencies is only "authorised" and not made an absolute condition of the undertaking, and hence the number of municipal electricity trading accounts in which no provision is made either for depreciation or a reserve fund.

In the article upon "Local Audit," by a Legal Contributor, in our issue of August 14th, attention was directed to the extravagance under the head of wages, which a careful auditor might deal with.

This question of wages is a very important one in connection with those undertakings which are controlled by the labour-governed municipalities.

From our knowledge of the methods adopted in drawing up the accounts of municipal electrical undertakings, we are convinced that if a searching and absolutely independent audit were made, many workings of wheels within wheels would be exposed to the enlightenment of ratepayers. How frequently, for instance, when it is considered that the occasion demands it, is the salaries and wages item manipulated, certain proportions of these being included under quite different headings—such, for instance, as buildings, especially while extensions are being carried out. In this way the working costs are made to appear lower than they really are, and consequently the net result of the year's working is swollen to the same extent.

ELECTRICITY IN MINES.

By T. CAMPBELL FUTERS.

(*Concluded from page* 288.)

The great trouble hitherto has been caused by the motors being too small for the work they had to do. Many armatures have burnt out, and the risk of firing an explosive mixture has been greatly increased; but further than this, the stoppage from this or any other cause is a reduction of the output and consequent loss. The motors should be enclosed and be able to do their work without sparking, and this can be accomplished by the simple process of making them bigger; and no motor ought to be sent into the workings of a mine unless it can do, without sparking, at least 25 per cent. more work than it will be required to do, and after six hours' run at full load, the temperature rise should never exceed 60° to 80° above that of the mine. Of course, it is important to keep the weight and dimensions to a minimum, but it is a mistake to do so at the expense of the *usefulness* of the machine; and the brush-gear of coal-cutter motors should be designed to minimise, as far as possible, the sparking due to the vibration of the machine.

As to danger from cables breaking, there ought not to be any, as cables should not break; but so long as inferior cables, working at a high density, are led into workings, tied up to the timbering or a cheap insulator by pieces of string, with badly twisted dry joints, what else can be expected? And this is the class of work that is being done at the present day. The idea of tying cables up by pieces of string is to prevent the cables from being broken in the case of a roof fall. The inventor of this brilliant system seemed to forget that a heavy enough fall might occur, not only to carry the cable to the floor, but to crush or even sever it.

Braided and insulated, armoured, concentric, and twin cables have all been suggested as the best, but all are liable to be bruised or broken by a heavy fall. To bury them is objectionable; to run them in iron piping is difficult and expensive, and in wet places they would rapidly corrode; and as a simple means to ensure complete protection, the writer has suggested running plain highly insulated cables in strong wood casing, shown in fig. 2. This casing, which may be creosoted or haskenised, if laid upon the floor, or fixed to the walls, is strong enough to resist a very heavy fall, would be practically damp-proof, and flexible enough to yield to an upheaval of the floor; it cannot be touched or interfered with by workmen, and can be examined at any moment by unscrewing a length of capping. This should be led as close to the machine as possible, leaving only a minimum length of trailing cable. For traction, however, bare overhead wire is necessary; but it is questionable if it will ever become a suitable means of haulage in this country. Shaft cables should be highly insulated and armoured with galvanised iron wires covered with compound. The writer has adopted the method shewn in fig. 1 for suspending these, quite clear of everything, and they are connected to cast-iron watertight junction boxes at both top and bottom, with large taper and screwed socket terminals, mounted upon a slate base. The armouring is, of course, earthed, but so long as the insulation between the armouring and conductor is not damaged, no leakage can result.

For underground lighting, wood casing or lead covered cable is preferable to steel tubing, owing to the rapid corrosion of the latter and danger of stripping the insulation when drawing in the cables.

Switches, fuses and starting switches have also generally been too small and of inferior design, and so long as colliery managers are in the hands of electrical engineering firms in keen competition with each other, with no standard of quality for guidance, this state of things will probably continue. All switches for underground work in exposed positions should be strongly encased, have ample contact surface and a low current density; and starting switches should be fitted with automatic no-voltage and overload release. Fuses should be simple, easily replaceable, in flame-tight

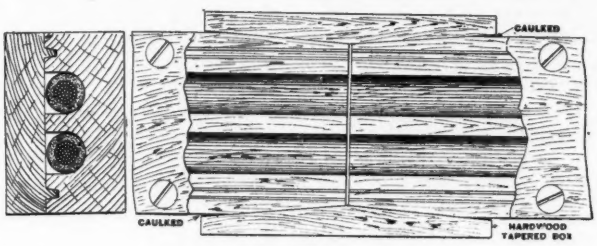


Fig. 2.

boxes, and arranged to blow with not more than 20 per cent. overload.

Distribution should be as far as possible controlled from the main switchboard on the surface, or a main board situated at the bottom of the downcast shaft. They should have positive and negative slates, and double-pole switches and fuses.

Generally, too much stress connot be laid upon the necessity of having everything of the very best quality and carefully designed; strict supervision and a high insulation resistance test should be rigidly enforced. Periodical tests should be thoroughly carried out, and any fault located and put right without delay.

The question of voltage, and the installation of three-phase or continuous current has given rise to considerable discussion. Three-phase induction motors have been advocated, as they get rid of the commutator, but against this there is greater starting difficulty, and slip rings are as objectionable as the commutator. The only real advantage three-phase can have over continuous current is in the use of higher pressures, and so reducing the cost of line wire; but, it is to be remembered that, though the workings of a colliery may exceed a distance of one mile, it would probably rarely be necessary to transmit any great amount of power beyond that distance, and it is generally acknowledged that up to one mile there is no saving in first cost by adopting three-phase in preference to direct current; and, further, the introduction of transformers only complicates matters, and adds another risk of breakdown. On the other hand, for some purposes, induction motors may be more suitable than continuous current motors, but these occasions are so rare as scarcely to justify the installing of three-phase plant.

Generally, where there is a group of collieries, and it is desired to transmit energy to them from one centre, a high pressure three-phase alternating installation may prove cheaper and more economical than a continuous current one; but for a large colliery supplying its own energy there can be no question that a 500-volt continuous-current plant would prove to be best, and a well-arranged three-wire system would probably save more copper in line-wire than three-phase working. Altogether too much has been made of the saving in line-copper by the advocates of three-phase installations.

So far, with good work no trouble of any consequence has been experienced with pressures up to 500 volts, and there need be no hesitation in carrying such a pressure to the the coal-face; but this is about the limit. The higher the pressure the more difficulty with the insulation, and to anyone fully conversant with the conditions of mining work, it is simply absurd to think of introducing pressures in the workings, of 1,000 volts and over.

Whilst electrical energy can with advantage be applied to all colliery machinery underground, and to much on the surface, it is not desirable, as some engineers have proposed, to replace the heavy steam winding and pumping engines with electric motors. These are usually placed comparatively close to the steam boilers, and therefore there can be no saving in first turning the steam energy into electrical, before applying it. Winding engines at their best cannot be made economical owing to the constant stopping and starting, and with quick winding, energy is not only used to start the load, but also to bring it rapidly to rest. Where it is required to supply energy from one centre, to a group of collieries, the conditions are altered, and the introduction of electricity for winding and pumping may result in a considerable saving, but there is no need to go to extremes.

Besides generating electricity for colliery purposes, it might with advantage be extended to supply light to the cottages, shops and streets of the colliery village, which would, no doubt, give a fair return on the capital laid out. Much more might be done in utilising slack coal and dirt, by the erection of proper furnaces, and even the erection of destructors to burn the village refuse, which, especially when coals are supplied free to the workmen, has a much higher calorific value than town's refuse, would probably prove a paying investment.

CARRIAGE OF MERCHANDISE ON ELECTRIC TRAMWAYS.

By THOMAS UPTON,

Goods Traffic Manager to the South Lancashire Tramways and Liverpool and Prescot Light Railway Companies.

(*Concluded from page* 293.)

There are also so many matters to be continually borne in mind by the clerical and porterage staff actually dealing with the receipt and forwarding of traffic, that it becomes a necessity to issue for their guidance special instructions in the form of "standing orders" covering such matters as—

The proper quotation of rates, with the necessary references to risk for loss, damage, or delay.

Injuries to the public and servants of the company on the latter's premises.

Supply of plant, trucks, sheets, sacks, ropes, &c., to the depôts, and the disposal of surplus plant *en route*.

Disabled stock and loads requiring adjustment in transit.

The proper loading and sheeting of wagons, and binding of loads to ensure safe transit.

Collection and delivery of merchandise and the proper handling of it.

Warehousing of merchandise, provisions, &c., and wharfage of oils or other dangerous liquids, vegetable fibres, &c.

Correct invoicing of merchandise, charges, &c.

Loading of live stock in disease affected districts, and the cleansing of wagons as required under the Board of Agriculture regulations.

Merchandise received unentered, particulars to follow, and missing.

Seizure of goods at depôts under writs and stoppage of goods in transit.

Proper rendering of accounts and keeping of correspondence.

Accommodation provided at depôts, &c.

Another matter of some importance is that of "sundry charges" made to firms by the railway companies for services rendered, but which many consider should be or are included in the rate charged for conveyance. When the nature of the services performed, however, are looked into, it will be seen that the charges so made are not, and could not have been, included in the original rate for conveyance, therefore it may be reasonably expected that somewhat similar charges will be made in tramway and light railway working, and will include charges for :—

Cartage beyond a fixed boundary of, say, one mile radius from any depôt at which the rates charged include collection or delivery service.

Special cartage rate for traffic conveyed at "Station to station" rates, or for articles of exceptional weight or bulk, say, over 3 tons each, and requiring special facilities for handling.

Small charge for the special facilities provided by the company for loading or unloading of such heavy articles.

"Split" delivery charges where firms send merchandise in bulk, at a cheaper rate than would otherwise be charged, and then divide up the bulk into small portions and instruct the company to deliver to various customers.

Charges for second cartage, through no fault of the company.

The loading and unloading of merchandise where such service is not included in the rate charged for the conveyance of the merchandise.

Shooting, weighing, measuring, screening and making up of flour, grain and seeds.

Cellaring and stacking of beer at hotels, &c.

Weighing net, uncovering and re-covering, or opening boxes and replacing of bacon and hams.

The cording and casing of teas, &c.

Marking and numbering of packages.

These services are of daily occurrence, and take up a great deal of valuable time which can ill be spared, and in many instances men's time is wholly occupied in the work, the carriers are therefore put to expenses they would not otherwise be, or otherwise it could be included in a conveyance rate. A trader will state that his work only occupies the matter of a few minutes and that the charge made is unreasonable ; but consider all such minutes occupied on behalf of the many and various traders added together, and the case for such charges being made is strengthened and apparent, although the writer is of opinion that the charges made in many instances might be reduced. This, however, is unlikely, as the railway companies do not care for the work and responsibilities entailed thereby.

The conveyance of merchandise on electric tramways and light railways will have, without doubt, far-reaching and beneficial effects to the traders in general, inasmuch as they will obtain quicker transit, less damage to their traffic in transit, besides the rates for conveyance being considerably reduced, in some cases, probably, as much as 50 per cent., but, generally speaking, say 25 per cent. all round.

In country districts the introduction of electric traction must be of incalculable importance to the agriculturists, and farmers and landowners would do well to encourage such traction by all means in their power, giving as it does the very facilities required, being far superior to any service of motor-vans that might be put on the roads. Although the latter would be able to go up to the farms, the tramway could be laid so as to be equally convenient to the farmer, for the motor-van would be only able to take, say, six or seven tons, and would have to go in most cases long distances to the nearest railway station. On the other hand, the farmer would be in a position to load at will several tram wagons with a capacity of, say, 16 tons each, saving the cost of loading to motor and from motor to railway wagon at the railway station, reducing the rate accordingly and getting a quicker transit without transhipment of the produce and the consequent delay. This would be brought about by the use of flat-deck wagons with detachable bodies, and in many cases the tramways would be in a position to convey the traffic to the markets direct, at rates much below those charged by the railway companies and in less time.

For small quantities of produce a special van could be run at stated times each day round to the various farmers, and the traffic gathered *en route* at much less cost than could be done by motor-van or by carts. It need hardly be pointed out that heavy motor-vans would not be able to go everywhere on a farm, and that it would be necessary for the farmer to bring his produce to some suitable spot on his land for loading purposes.

It would be idle to attempt in this article to organise a complete system of merchandise distribution ; but if facilities were given, it is safe to say that the advantages to be derived therefrom would be fully appreciated, and the traffic would grow rapidly, and during developments, experience would be obtained as to the requirements of the various classes of merchandise, which it is impossible to

fully appreciate in advance; further, the effects of such developments upon the districts covered is bound to be of far-reaching extent in furnishing facilities for the distribution of merchandise which have been hitherto unobtainable.

SOUTH AFRICAN NOTES.

(From our Johannesburg Correspondent)

August 3rd, 1903.

Kalk Bay Muizenburg, C.C.—Mr. Thomas Bennett, M.I.C.E., engineer of the Kalk Bay-Muizenburg Municipality, has sailed for England per the R.M.S. *Briton* for the purpose of selecting and purchasing material and plant for the drainage and electric lighting schemes. He expects to be away about four months, and will return to commence work on the schemes in the early spring.

Mafeking, C.C.—A special meeting of the Town Council was held last week to consider the question of lighting the town. It was decided to light it by means of electricity, oil engines being specified to drive the generators, and a public meeting is called to consider the question and to sanction a loan of £6,000 for the purpose.

Graaff-Reinet, C.C.—The Municipal Council has decided to call for tenders for a scheme of electric lighting for the town.

Durban, Natal.—The Town Council having recently obtained Parliamentary powers to borrow money for municipal works, decided at a special meeting to obtain a loan of £300,000, and the town treasurer, who on previous occasions has performed similar service, has been directed to proceed to London for the purpose of arranging the loan; £100,000 is to be devoted to a new telephone system, the rest being expended in electric light and trams, water and sanitary schemes and extensions.

It has been decided to equip the cranage system in the Hartley Barry Dock scheme with electric motors.

Robinson G.M. Co.—A fire broke out, originating in an electric motor, in the chlorination room at this mine this week, and caused a damage of £350.

Transvaal Townships.—The following towns in the Transvaal have, by a recent Ordinance, been endowed with full municipal powers; this will have an appreciable effect on the electric lighting schemes, &c., which many of them have been considering:—Krugersdorp, Boksburg, Germiston, Pietersburg, Heidelburg, Klerksdorp, Middleburg, Potchefstroom and Standerton.

Ophirton, Johannesburg.—A well attended meeting of Ophirton standholders took place this week to consider the question of tramway extension. They finally resolved: "That the standholders present are willing to pay the Town Council, in the form of a special rate, the sum of £1 per stand per annum for three years, as a contribution towards the construction of a tramway from Johannesburg to the township of Ophirton, and also such annual sum as may be required to cover loss on working for the first three years." It was also decided to petition the Town Council for a scheme of electric lighting.

Technical Education.—The Commission deputed to report to the Government on the question of Technical Education in the Transvaal, handed in to the Legislative Council sitting at Pretoria, a lengthy report, the following being a summary:—The Commission recommend that temporary premises be acquired where provision may be immediately made to carry on, locally, the work of a mining course, embracing four years of a standard at least as high as that of the course of mining engineering of the South African School of Mines. Other instruction of a university character would also be provided, and classes should, from the outset, be held in literary and other subjects for the benefit, among others, of students preparing for university degrees. The Commission recognise that one of the first steps to be taken is the appointment of a man who, subject to the control of a general governing body, should be entirely responsible for the technical work. They consider the emoluments of such a man should not fall below £3,000 a year, without residence, and that the area of this selection should embrace the whole of the British Empire. The Commission further recommend the establishment of a permanent institution in Johannesburg, and that the Government should set aside Plein Square as the site thereof. They also recommend the immediate requisition of a site for the teaching University for the Transvaal and other parts of South Africa, which may be willing to co-operate with the country in venture. The site should be within convenient distance of Johannesburg and Pretoria, and as near as possible to the mines of the Witwatersrand. A minority report recommends the suburbs of Johannesburg as the site of the permanent University.

NEW PATENTS APPLIED FOR, 1903.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

17,367. "Improvements in safety devices for strong current overhead conductors." C. C. van der Valck. August 10th. (Complete.)

17,399. "Process of decomposing water by electrolysis." G. T. Fuery. (W. F. M. McCarty and W. S. Beebe, United States.) August 11th. (Complete.)

17,431. "Improvements in or relating to electric joints or connections for railway trains." S. Savelsohn. August 11th.

17,460. "Improvements in or connected with incandescent electric lamps." G. Davis. August 12th.

17,482. "Improvements in electric arc lamps." W. Squire. August 12th.

17,564. "Improvements in junction or inspection boxes and like inspection fittings used with electric wiring." E. White and J. Waldron. August 13th. (Complete.)

17,587. "Improvements in the manufacture of electrodes for electrolytic purposes." G. W. Johnson. (The Chemische Fabrik Griesheim Elektron, Germany.) August 13th.

17,601. "Improvements in system of electric lighting." H. Leitner and R. N. Lucas. August 14th.

17,605. "An improved trolley head and arm for electric traction wires." J. J. Carter. August 14th.

17,632. "Improvements in electricity meters." H. T. Harrison. August 14th.

17,644. "Means for electrically operating from a distance type-writing machines, type-printing telegraphic apparatus, and the like." J. Pilsatneeks. August 14th.

PUBLISHED SPECIFICATIONS, 1901.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

13,466. "Improvements in railway switch and signal apparatus." Westinghouse Brake Co. and E. de M. Malan. Dated July 2nd.

13,468. "Improvements in electrical interlocking for railway signalling." Westinghouse Brake Co. and E. de M. Malan. Dated July 2nd.

13,501. "Improvements in apparatus for the transmission and automatic distribution of mail matter." G. A. Owen. Dated July 2nd.

13,507. "Improvements in and relating to vapour burning apparatus." A. Kitson. Dated July 2nd.

13,510 "Electrical workmen's time checking clock." C. T. Mason and S. R. Brown. (Trading as Mason & Brown.) Dated July 3rd.

13,560. "Improvements in and relating to plating or braiding machines." E. L. Thorp. Dated July 3rd.

13,663. "Improvements in telephone transmitters." E. B. Fahnestock. Dated July 4th.

13,747. "Page printing telegraph." G. S. Musso. Dated July 5th.

13,840. "Improvements in stops for trolleys on electrically-propelled tramcars and the like." E. J. B. Lowdon, K. Lowdon and G. Balfour. Dated July 8th.

13,872. "Improvements in or relating to apparatus for changing the colour of the light employed in illuminating clock faces, transparent pictures, advertisements and the like." W. H. Stockall. Dated July 8th.

13,924. "Improvements in ascertaining the position of ships." W. M. Walters. Dated July 9th.

13,947. "Improvements in and connected with electrical heaters for water and other liquids." H. M. Hill. Dated July 9th.

13,956. "Improvements connected with circuit breakers and brakes on electric railway and tramway vehicles." British Thomson-Houston Co. (W. B. Potter and C. D. Clarke, Schenectady, New York, U.S.A.) Dated July 9th.

14,064. "Improvements in illuminating devices." F. de Mare. Dated July 10th.

14,156. "Improvements in or connected with apparatus for optical projection for luminous advertising and other purposes." Electrical "Lumiscriptor" Co. and W. Claypoole. Dated July 11th.

14,235. "Improvements in or relating to audible electric signalling devices." S. A. Brown and J. W. Points. Dated July 12th.

14,404. "Improvements in electric switches." H. H. Lake. (W. P. Pinckard, 930, South 20th Street, Birmingham, Alabama, U.S.A.) Dated July 15th.

14,415. "Improvements in and relating to means for indicating the impact of bodies at a distance, particularly applicable for recording targets." J. Urrutia y Motta. Dated July 15th.

14,466. "Improvements in electrical storage batteries or accumulators and in electrolytes for electric batteries." P. Steins and P. J. Smith. Dated July 16th.

14,477. "Improvements in or connected with machinery or apparatus for weighing tea and other granular substances." J. P. Stubbs. Dated July 16th.

14,509. "Improvements in and relating to mechanism for supplying weft filling to looms for weaving." W. H. Baker and F. E. Kip. Dated July 16th.

14,576. "Process and apparatus for utilising the waste heat of metallurgical operations." J. Imray. (Soc. Electro-Metallurgique Française, Froges, Isére, France.) Dated July 17th.

18,880. "Automatic electric fire alarm." W. J. Brewster. Dated September 20th.

19,072. "Improvements in thermostatic switches." W. F. Singer. Dated September 24th.

19,228. "Improvements in systems of electrical distribution." British Thomson-Houston Co. (A. R. Everest.) Dated September 26th.

20,690. "Improvements in elevated and sub-aqueous railways and in motor vehicles therefor." R. C. Sayer. Dated December 3rd.

14,670. "Improvements in connection with electric circuits." A. H. Howard. Dated July 18th.

14,952. "Improvements in and relating to railway signalling apparatus." A. J. Boult. (A. Neelemans, 6, Avenue Marnix, Brussels.) Dated July 23rd.

15,155. "Improvements in and relating to conduits for carrying electric conductors." H. Hirst and F. Boyes. Dated July 25th.

15,216. "Improvements in electrically-propelled vehicles and permanent way therefor." A. S. V. Burnaby. Dated July 26th.

15,315. "Motor cycles." G. W. Manson. Dated July 29th.

15,366. "Improvements in safety devices for electrical apparatus." P. Rudhardt. (Date applied for under Sec. 103 of Patents, &c., Act, 1883, January 25th.) Dated July 29th.

15,463. "Improvements in secondary battery plates." B. Kuettner. Dated July 30th.

15,579. "Improvements in or relating to electrolytic apparatus." A. J. Boult. (American Alkali Co., Philadelphia, Pennsylvania, U.S.A.) Dated August 1st.

16,150. "Arc lamp safety winch." J. Lawrence. Dated August 12th.

16,514. "Improvements relating to the working of breech-loading ordnance." A. T. Dawson and J. Horne. (Patent not yet due for sealing.) Dated August 16th.

16,712. "Improvements in or relating to automatic apparatus for controlling the speed of tramcars, automobiles, and other electrically or mechanically propelled vehicles." H. E. Yerbury. Dated August 20th.

16,748. "Improvements in apparatus for operating bulkhead doors, hatches, or the like." P. M. Justice. ("Long Arm" System Co., Corner Lake and Wason Streets, Cleveland, Ohio, U.S.A.) Dated August 20th.

16,754. "Improvements in machines for copying and reducing steel dies engraved in relief." P. Jensen. Maschinenfabrik Elektrogravure, Leipzig Sellerhausen, Germany.) Dated August 20th.